Electrical World

Published by McGraw Publishing Company, Inc.

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

Vol. 63 NEW YORK, SATURDAY, FEBRUARY 28, 1914 No. 9

Congress Should Make Haste Slowly

The great diversity of opinion already expressed before Congress on pending anti-trust measures is illuminating in the knowledge which it gives the country of widely varying business practices. It is an effective cry to Congress to make haste slowly. What is done in haste will be repented in sorrow if the legislation unduly hampers the great business structure of the country. The weapon which is sharpened for monopoly may in fact prove to be a weapon against the small manufacturer. For instance, on the question of maintenance of re-sale prices, the sentiment expressed before the committee as well as by members of the committee is not unanimous. There is a faction that would definitely prohibit the maintenance of resale prices because, forsooth, that is one of the practices of monopolies. A witness points out that, if this is done, the large manufacturer can accomplish the end sought to be prohibited by opening a chain of stores, a practice which the small manufacturer has not the means to follow. The testimony thus far heard by committees of Congress is not by any means representative of all of the main classes of industry. It is not representative of all sections of the country. It is representative of the widely diversified business activities of the nation, and is emphatic in revealing the fact that few industries are without concern over the outcome of the legislative program. Many industries have not presented testimony. Many companies have offered no suggestions. If all were represented, the testimony would reveal still stronger reasons why deliberation, analysis, investigation for facts should precede actual law-making.

The Engineer as a Speaker.

The very interesting plea of the city manager of Dayton, Ohio, outlined elsewhere in this issue, concerning the public-speaking ability of engineers, should make an especially strong appeal to those responsible for the proper education of our future electrical engineers. In none of the various engineering and technical fields is the necessity for clear and exact exposition by word of mouth more important than in our own. The public is painfully ignorant of even elementary electrical matters—a compelling reason for the formation and activities of the Society for Electrical Development. Moreover, the work of no engineer has so great or so important a bearing upon the business and home life of a community as that of the electrical engineer. In no technical field are there so many points of intimate contact between the people and those few especially educated in their craft as in our own. Therefore, it would seem clearly desirable that the electrical engineer of the immediate future be sent out into the world with not only the necessary equipment of technical knowledge but with at least an elementary training in the persuasive art of public speaking, a fact that progressive colleges are now beginning to appreciate.

Electric Steering for Automobiles

As purchasers of gasoline automobiles are now demanding on their cars devices which will all but eliminate muscular exertion, it has been proposed that electrical apparatus be provided for steering. Some drivers find steering tedious, especially on long trips, over rough roads, because of the continuous vibration transmitted to their wrists through the steering column. This objection could be removed to a large extent by employing electrically controlled steering apparatus. And in justifying this further electrification of gasoline cars it may be pointed out that steering requires considerably more muscular effort than the operation of shifting gears for which electricity is already used on many cars. Objections have been raised that electric steering will complicate the cars too much, besides requiring considerably higher battery ratings. Both the practicability and the reliability of electric steering have been demonstrated by the successful use of this principle on ships. With a good storage-battery equipment on an automobile the possibility of interruption to its energy supply would be remote; and, as the power demand of a motor-driven steering device is intermittent and would probably not exceed 30 watts, the battery rating would not have to be much increased. In addition to eliminating the tediousness of long tours, electric steering would make possible one-hand control at all times, and the bulky steering wheel and column, which now hinder entrance to the driver's seat, could then be replaced by some small, compact steering handle.

Successful Electric Mining Plant

One of the striking papers read at the recent convention of the American Institute of Mining Engineers was that detailing the applications of electricity in the iron mines at Mineville, N. Y., one of the first instances of such application and apparently one of the most successful. This particular group of mines yields magnetite to the extent of about 700,000 tons per year, and of this about four-fifths is treated by magnetic separation to give a product of exceptional purity. After

ten years' experience it has been found that a cost of 25 cents per ton of ore shipped will cover all the electric energy required to deliver the ore on the cars, including mining machinery underground, hoisting from a 900-ft. shaft, crushing and magnetic separation, together with the lighting and miscellaneous services of the mines. This is indeed a good record for economy. Before the electric plant was in full use steam was employed to lift the ore out of the mine. Under the old régime the cost of hoisting was 7 cents per ton, while with electricity it has dropped to 2 cents. An even more important feature of the equipment is the magnetic ore separators which are in use on a large scale. The equipment is neither complicated nor costly to operate, and the net result is to obtain a concentrate of very excellent quality at comparatively low cost. The regular product of the magnetic concentration is guaranteed to carry 70 per cent of metallic iron, the theoretical amount in absolutely pure magnetic iron ore being 72.4 per cent. Now and then carload lots of a concentrate will run up to 71.2 per cent. These figures show better than any amount of argument the advantages of magnetic separation in producing a pure product, and the quality can be held almost absolutely uniform without regard to the iron content of the crude ore, which in this case ranges from 25 to 55 per cent. Altogether, this electrical mining equipment, while not on a colossal scale, is a particularly fine example of the economies to be secured in mining and treating ores with the aid of a complete electrical equipment.

The Development of a Railway Plant

As a generating station the Louisville plant described in the current issue is not widely different from many a well-designed plant of medium size. However, it is not a little instructive to glance at the causes which brought the necessity for a completely new equipment. The station furnishes energy for about 260 miles of track, of which about two-thirds is in the city and the rest interurban. The growth of the city and the extension of interurban traffic have made some rather startling changes in the local conditions. In ten years from 1902 to the present the average daily output has risen to more than three times its value at the beginning of the decade. The maximum peak has increased nearly fivefold. These figures bespeak large gain in traffic and also a far greater mileage of track and of car services. Even more striking, as showing the change in conditions of equipment, is the output per car-mile, which during the period in question has risen from 1.5 kw-hr. to nearly 4 kw-hr. This means heavier and faster cars, in the use of which the interurban work has undoubtedly been a considerable factor. It is easy to understand, therefore, how the original plant was outgrown. The last touch was added, however, when the city of Louisville turned the bulk of the water supply from which circulating water was obtained in the old plant into its rapidly increasing sewer system. Then a move had to be planned.

The new plant described in this issue is situated on the bank of the Ohio River, where the water supply is reliable, and at the same time where a site could be obtained above the maximum high-water stage of that somewhat erratic stream. The plant as now constructed contains two 6000-kw horizontal turbines with room for six more when necessary. The boiler and condenser equipment is thoroughly up to date like the rest of the plant. The value of the turbine equipment and the importance of every step toward economy are well shown by the fuel consumption, which the load conditions have caused to be nearly 3 lb. of coal of 12,000 heat units per lb. for each kilowatt-hour. One can easily imagine when a first-rate modern plant is under load conditions which give this consumption of fuel what the situation would be with an equipment such as would have been considered thoroughly first class ten or fifteen years ago. Even the shrewdest engineering skill cannot keep down the coal consumption beyond a certain point in the face of natural difficulties of load which are beyond control.

Theories of High-Frequency Resonance

In the present issue Mr. J. Hettinger brings forward some interesting speculation regarding the behavior of coupled circuits used in radio-telegraphy. Each of the several methods which have thus far been offered for treating the highly complicated interactions in such systems appears to involve at least a few partially compromising assumptions and omissions, and in this regard Mr. Hettinger's ideas do not depart from those already advanced. On analysis it is often found that several different modes of expression result in the same ultimate set of conclusions. It might be said, for instance, that Mr. Hettinger has merely reversed some algebraic signs and considers the resultant current in his secondary as the sum of a series of free oscillations of the same phase instead of the difference of a single decaying free oscillation and a forced alternating current of the final amplitude. However this may be, the present graphical investigation of the action of a given few types of paired circuits should help a number of readers toward a better insight into the building up of large alternating currents in resonant networks driven by forced oscillations. It would appear almost immaterial whether the assumed forced oscillation is of the final resonant amplitude, as assumed by Zenneck, or of the initial half-wave amplitude according to Mr. Hettinger's suggestion, since in applying either theory to practical cases such constants would be introduced as might be needed to secure agreement with actual conditions. The expression derived for maximum amplitude at resonance is in terms of the amplitude of the original forced oscillation for the same circuit conditions, and hence is mainly useful in showing the usual relation between decrement and time required to reach full resonance.

In Mr. Hettinger's treatment of receiving apparatus the setting of a sharp line in minimum amplitude to

give detectable effect is noteworthy. This line, of course, corresponds to the current normally considered to mark the "limit of audibility," but consideration of its effect on the efficiency of a receiver should serve to bring to mind rather forcibly the looseness with which this limit is often treated. The matter of the integrative abilities of various detectors used in commercial radio-telegraphy is still in dispute, and many experts will disagree with Mr. Hettinger's classification of electrolytic and crystal rectifiers as of the type which depends for effect merely upon the amplitude and not on the persistence of oscillation. When the conclusions of the present article are interpreted from the standpoint of the large dependence of the response of rectifier detectors—in connection with the associated condenser and telephone circuits—upon the persistence of oscillations, sustained waves would appear to lead damped trains in their ability to produce indications. The outline of the cumulative action of the Poulsen-Pedersen "tikker" receiver seems directly in agreement with experimental facts, as is, unfortunately, the criticism to the effect that on account of its characteristic "hissy" response this instrument does not permit the use of a musical tone for reduction of interference. That this lack of pure signal tone need not be held against sustained wave transmission in general, however, has been shown by the recent practical applications of Fessenden's "heterodyne" receiver, which gives cumulative and integrative action along with true musical response of any frequency. The discussion of the relative values of sustained and damped waves is capable of indefinite extensions and, even when transmission phenomena are eliminated, can scarcely be treated in a single paper. It is believed, nevertheless, that Mr. Hettinger's article will offer much material for thought and that, while it does not contain completely acceptable solutions of all the problems discussed, it will be of much interest and value to the radio engineer.

Characteristics of Crystal Rectification

In radio-telegraphy one of the most generally used forms of receiving instrument is the telephone, in connection with a so-called crystal rectifier. The rectifier is a small lump of special substance, pressed tightly between a metallic point and a metallic plate. The special substance is commonly crystalline, such as a lump of silicon; but amorphous or non-crystalline substances exist which will serve the purpose, so that it seems the substance does not have to be crystalline. When an alternating current is made to pass through the device the resistance which the device appears to offer to one direction of current is very distinctly greater than to the other, so that the current which goes through is no longer a simple alternating current, but more nearly a throbbing unidirectional current; that is, a rectified current, such as will produce a one-way movement of a telephone diaphragm.

The wonderful simplicity, convenience and permanence of the crystal rectifier have made the device very popular as a receiver in radio-telegraphy. The widespread use of this rectifier brings the fact prominently into notice that the nature of the action is still very imperfectly understood. Some have tried to explain the action thermo-electrically, but with little success. All that is admitted without dispute is that the action is not microphonic or dependent on a loose electrical contact. It is best developed under a good tight contact from a blunt point on the crystal. Moreover, the surface of the crystal is ordinarily non-uniform. Spots of good action are found separated by areas of bad action, or even of reversed action, as the point is caused to meander over the surface. The best way to describe the action at present, so as to keep within the facts and on the leeward side of controversy, is to call it unilateral conduction, which is a glorified name for rectification and leaves the causes comfortably in the dark.

In a recent paper in the *Physical Review*, referred to in our Digest, Mr. Alan E. Flowers discusses certain experimental characteristics of crystal rectification, using crystals of galena. The rectification ratio, taken from the ratio of direct-current and alternating-current measuring instruments in the circuit of the crystal, was observed at various current strengths and also over a wide range of frequency. It appears from the results that, for a given current strength, the rectification ratio was surprisingly nearly constant at frequencies from 60 cycles to 180,000 cycles per second, being slightly greater at the high frequencies. This is a fortunate circumstance, so far as concerns the use of the device as a radio detector. On the other hand, the rectification tends to disappear with very feeble alternating-current supply, especially with large contact areas. It seems to be important to develop a fairly high current density under the contact, in order to secure good rectification. It is, perhaps, for this reason that some rectifying crystals are used, in practice, with the stimulus of a low direct emf applied to them, in order to enhance their sensitiveness to very feeble oscillating-current wave trains.

Although the theory of action is not discussed in the paper, yet the experimental results reported have a bearing on such theory. If, as appears, the rectifying action is as good at hundreds of thousands of cycles per second as at tens or hundreds, all thermal actions which can propagate themselves differentially through the mass from the contact point appear to be ruled out, because they are necessarily sluggish. The suggestion offers itself that the action is attributable to movements of electrons at or near the contact, which are hampered in one direction more than in the other. After all, we have no right to expect that electricity must move with equal facility along a conductor in either direction. It is very wonderful that no appreciable difference of this kind can be detected in wires or lumps of metal. We have become so spoiled by the remarkable indifference of metals, and pure metallic contacts, to direction of current that when we meet with dissymmetrical behavior in a metal-point-crystal-metal-plate combination we are greatly surprised.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

Society for Electrical Development an Accomplished Fact

Its minimum fund of $200,000 having been subscribed, the Society for Electrical Development, Inc., will take up its task of educating the public to "do it electrically" on March 1. The membership on Thursday morning was 1300, apportioned as follows: Central stations, 279; manufacturers, 173; contractors, 568; jobbers, 262, and miscellaneous, 18. Inasmuch as none of the pledges became binding until the $200,000 was subscribed, the society is now engaged in sending out bills to subscribers, and the returns already coming in indicate a very healthy interest in the work for which the society was formed. At the next meeting of the executive committee appropriations will be made for carrying on definite branches of activity. It is certain that the program for a national advertising campaign to educate the reading public in the use of electricity will be one of the first to receive consideration. No let-up will be made in the effort to increase the membership. That campaign will be carried on simultaneously with the co-operative and educational work for which the organization was brought into being, because there is no limit to membership or to the funds which may be raised. By this means it is hoped not only to widen the influence of the society but to place at its disposal greater funds to make its work more extensive and immediately responsive. The general aims and plans of the Society for Electrical Development have been outlined in these columns before. Its headquarters are located at 29 West Thirty-ninth Street, New York City.

Patent Reforms Urged

Free and frank discussion of administrative reforms in the Patent Office and in the court procedure dealing with patent cases marked the addresses delivered at the annual banquet of the Patent Law Association of Washington at Rauscher's on Feb. 21. Commissioner of Patents Thomas Ewing, representing the administration; Chief Justice Seth Shepard of the District Court of Appeals, representing the judiciary; Senator Poindexter, of Washington, and Representative Morrison, of Indiana, representing the legislative branch, and several members of the bar voiced the unanimous opinion that by co-operation alone could the evils that now exist in the patent system of the United States be eliminated. But, while criticising the administration of the patent system, the speakers declared that the system was the finest patent system in the world, that its administration was being conducted more satisfactory than ever before, and that the commercial supremacy of the United States rested, not on the customs houses, but upon the Patent Office.

Mr. Ewing said that the severest criticism of the patent system grew out of some seventy-five cases which have been pending for the last fifteen years and were still in the course of litigation. "Let's get rid of these cases, and prevent such delays in the future," urged Mr. Ewing, "and we will have done much to remove the criticism of the patent system."

Representative Martin A. Morrison, of Indiana, ranking member of the House committee on patents in the absence of the chairman, Representative Oldfield, pledged his earnest support to the Patent Office. He admitted that members of Congress were too prone to pass upon matters relating to the Patent Office without knowing anything about the system or its needs.

Chief Justice Shepard of the Court of Appeals urged the members of the association to aid personally in reducing the delay with which in many instances patent cases now drag on before the courts. The remedy for these delays, he said, in the last analysis, rested in the hands of the attorneys trying the cases themselves. He said that the same could be said of the delays in litigation of all kinds to-day. The efficiency of the judiciary in handling quickly the cases before them depended largely, he said, upon the attorneys' assistance.

Hearings on Anti-Trust Legislation

Hearings have continued during the past week before the House judiciary committee at Washington on the proposed anti-trust legislation of the administration, and time has been reserved for additional persons to appear up to the end of next week. Mr. Frederick P. Fish, former president of the American Telephone & Telegraph Company, will be heard March 6. Mr. Horace Stern, of Philadelphia, will appear March 4 to speak on "The Prohibition of Foreign Trusts from Operating in the United States." No date has been set for the discontinuance of the hearings before this committee.

Representative Covington and his sub-committee of the House committee on commerce are still at work drawing an entirely new Interstate Trade Commission bill. On the Senate side of the Capitol it is announced that the committee on interstate commerce, of which Senator Newlands is chairman, is framing an Interstate Trade Commission bill of its own. Senator Cummins and Senator Clapp, however, two of the Republican Senators on this committee, are not taking part in its deliberations, expressing the view that the Democrats will frame the bill irrespective of Republican members' ideas, although the other Republicans on the committee have not assumed this attitude.

Chamber of Commerce Committee on Trust Legislation

As a result of the meeting of the Chamber of Commerce of the United States in Washington two weeks ago a committee has been appointed to consider all proposed anti-trust legislation and to make preparations for taking a referendum through the commercial organizations of the United States. This committee held its first meeting in Washington on Feb. 24. The chairman is Mr. R. G. Rhett, Charleston, S. C. Other

members of the committee include President Charles R. Van Hise, University of Wisconsin; Mr. Guy E. Tripp, chairman board of directors Westinghouse Electric & Manufacturing Company, and Mr. W. L. Saunders, president Engersoll-Rand Company.

Municipal Plant a Possibility in New Orleans

Commissioner Lafaye of the Department of Public Property of the city of New Orleans is asking information from the heads of American cities of more than 150,000 population in relation to rates charged for electrical energy. It is said that this is the first move in an effort to reduce electric-service and gas rates in New Orleans. Possibly the movement will lead to the eventual establishment of municipal gas and electric-service plants, but the first endeavor will be to induce the New Orleans Railway & Light Company to reduce its rates. For street lighting, at any rate, the present rates would seem not to be excessive. These rates are $69 a year for all-night arc lamps on overhead circuits and $85 on underground circuits. The street-lighting contract will expire in September, 1915.

Cost of Chicago Street-Lighting Energy

In a report dated Jan. 15, 1914, addressed to the finance committee of the City Council of Chicago, Mr. Ray Palmer, commissioner of gas and electricity (the title now borne by the city electrician), repeats that 0.59 cent per kw-hr., plus $1 per lamp per year, is a fair and reasonable price for the generation, transmission and distribution of electrical energy by the Sanitary District for street-lighting purposes in the city of Chicago. Mr. Palmer says that the city's electric-lighting situation is in a serious condition at the present time and that the source of energy for lighting Chicago from the Sanitary District is unreliable, owing to various conditions not under the control of the Sanitary District, including the restricted flow of the water from Lake Michigan for the Chicago Drainage Canal.

The present rate paid to the Sanitary District for electricity for street lighting in the city of Chicago is 0.5 cent per kw-hr., and it is perhaps unlikely that the finance committee will decide to increase this rate, although the majority of the trustees of the Sanitary District have said that any extension of service is contingent upon an increase in rate.

Promotions in the Commonwealth Edison Organization

At the annual meeting of the stockholders of the Commonwealth Edison Company held in Chicago on Feb. 24 the following directors were re-elected: Messrs. Henry A. Blair, Benjamin Carpenter, Samuel Insull, Robert T. Lincoln, John J. Mitchell, James A. Patten, John G. Shedd, Byron L. Smith and A. A. Sprague. Immediately following the stockholders' meeting, the board of directors met and elected the following executive committee: Messrs. Samuel Insull, chairman; John J. Mitchell, Byron L. Smith, A. A. Sprague and James A. Patten.

Owing to the desire of Mr. Robert T. Lincoln not again to be elected as vice-president, and to the great growth of the company's business, it was deemed an opportune time by the board to make changes in the executive organization of the company, which was done by changing the by-laws and creating a staff of working vice-presidents. The following officers were elected: Mr. Samuel Insull, president; Mr. Louis A. Ferguson, vice-president in charge of the contract, operating and construction departments; Mr. John F. Gilchrist, vice-president in charge of the purchasing, stores, transportation and statistical departments; Mr. William A. Fox, vice-president in charge of finances, securities and claims, with supervision over the secretary and treasurer and his departments; Mr. John H. Gulick, vice-president in charge of accounting, with supervision over the auditor and the auditing department; Mr. Edward J. Doyle, secretary and treasurer; Mr. George E. Burns, assistant treasurer; Mr. Robert L. Elliott, assistant secretary; Mr. William S. Kline, assistant secretary; Mr. Henry E. Addenbrooke, auditor; Mr. R. H. Williams, assistant auditor; Mr. Harry A. Weigle, assistant auditor.

Formation of Jovian Relief Fund Urged

Some of the Jovians of Texas, and more particularly Mr. A. J. Binz, of Houston, are advocating the formation of a Jovian relief fund, from which worthy members of the order in financial need may be relieved. Such a fund for local use has been established by Houston Jovians and has done good work. Mr. Binz urges every Jovian to give study to the subject and says that he is going to push the matter throughout the United States.

Missouri Convention to Be Held on Mississippi River Steamer

The Missouri Electric, Gas, Street Railway and Water Works Association will hold its annual convention, May 21 to 23, aboard the steamer *Quincy*, making a round trip from St. Louis, Mo., to Keokuk, Ia. The boat will leave St. Louis at 10 a. m. on Thursday, May 21, arriving at Keokuk the following day at noon. After an inspection of the hydroelectric development of the Mississippi River Power Company the party will board the boat for the return trip to St. Louis, arriving at the latter city at 5 p. m. Saturday. Mr. F. D. Beardslee, secretary of the association, announces that the round-trip fare, including meals, will be $15, with half-fare rates for children. Reservations can be made through the secretary at 315 North Twelfth Street, St. Louis, Mo. Sessions of the convention will be held on the boat during both trips.

Meter Hearing at Boston

The committee on public lighting of the Massachusetts Legislature gave a hearing on Feb. 13 upon bills requiring electric, gas and water companies to furnish customers with duplicate meter readings and reducing the yearly charge for the use of electric meters from $9 to $5. Advocates of the former contended that customers are entitled to be informed as to their meter readings at the time of the meter reader's visit, in the interests of speedy adjustment of errors. Mr. Everett W. Burdett, Boston, counsel for the Massachusetts Electric Lighting Association, pointed out that the Boston Edison Company provides duplicate readings on request, but that only 200 out of 60,000 patrons ask for these. The central stations of Massachusetts encourage the reading and checking of meters by customers, and the cost of supplying the duplicate when it is not asked for seems a needless expense. Mr. Burdett opposed the reduction of the electric-meter charge from $9 to $5 on

the ground that the consumer using only $5 worth of energy in a year is unprofitable to the central station. The cost of meter maintenance is from $7 to $8 per annum, including a loss of $2.34 in the potential coil. Mr. W. D. King, of the Peabody (Mass.) municipal lighting plant, opposed the bill, stating that the loss in the meter averages about $4.20 a year at 12 cents per kw-hr.

Progress of the Jovian Commercial Division

To carry out some of the plans outlined in a general way at the recent Jovian Congress in New York, active work has been started by the Commercial Division of the Jovian Order. In discussing the progress of this work with a representative of the *Electrical World*, Mr. Ell C. Bennett, St. Louis, secretary of the order, said that plans for bringing about co-operation of the architects and electrical men in the principal cities of the country had been carefully considered. It is hoped by such co-operation to secure proper specifications for all electrical installations in buildings, to insure the use of none but first-class material properly placed and to provide for adequate rigid inspection. When these conditions can be brought about the irresponsible contractor putting in electrical apparatus of insufficient rating and poor quality will be eliminated and the reliable dealer submitting a fair bid based on cost of first-class material and construction will be protected.

Thus far the best suggestions of plans for such co-operation indicate that each community should be handled locally by a commitee composed of five men, namely, a representative of the central station, a contractor, a jobber, a manufacturer and an electrical engineer. According to the suggested plans, the services of this committee are to be at the disposal of local architects. In towns where there is a local architects' association the committee will endeavor to meet with that body and enlist its aid in bringing about the desired co-operation. Where no such organization exists action with the leading architects is planned.

In cities where a local inspection bureau is maintained either by the municipality or by insurance interests an effort will be made to secure the services of an inspector on the Jovian committee. Thus, with the architects, the electrical interests and the inspectors working in harmony, it is hoped to achieve a general reduction in life and fire hazards. Better material and better construction will be the watchwords of the committee.

Mr. Bennett also reports that the work of the employment bureau is progressing with satisfying results and that a suggestion sent to Jovian headquarters from the Pacific Coast proposing the establishment of schools of salesmanship is receiving careful attention.

Cable and Telegraph Statistics

Preliminary figures of the forthcoming quinquennial reports on the ocean cable systems, land telegraph systems and wireless telegraph systems of the United States have been given out by the Bureau of the Census. The statistics relate to the years ended Dec. 31, 1912 and 1907, and cover commercial operating companies only. Systems operated by the federal government for military or commercial purposes either in Alaska or the insular possessions, and telegraphs owned and operated exclusively by railways, are not included; neither do the figures include the incidental telegraph business done by telephone companies over their own wires.

Ocean Cable Systems

Included in the number of ocean cable systems is one system operated by a land telegraph company. The financial details of this and the number of employees, not having been segregated in the single report submitted, are made a part of the report for land telegraph systems. The miles of cable and number of cable messages, however, are embraced in the cable system's report. The mileage of ocean cables is that owned or leased by the operating companies and is the entire length of such cables wherever located. The financial statistics, therefore, concern to some extent operations in foreign countries. The statistics of the two foreign companies having cables landing in this country and doing business here are not included in either census. These companies are the Deutsch Atlantische Telegraphengesellschaft and the Compagnie Française des Cables Télégraphiques. Although the number of operating companies remained the same during the semi-

WIRELESS TELEGRAPH SYSTEMS

	1912	1907	Per Cent of Increase, 1907-1912
Number of companies or systems	4	5	—20.0
Number of messages	285,091	154,617	84.4
Number of tower stations	74	117	—36.8
Income, total	$669,158	$106,791	526.6
Net income	4,738	.....	.....
Expenses, total	664,420	160,329	314.4
General operation and maintenance	588,712	117,480	401.1
Interest and taxes	7,826	5,562	40.7
All other expenses	67,882	37,287	82.1
Net deficit	.....	53,538	.....
Balance sheet:			
Assets, total	10,377,197	32,958,897	—68.5
Construction and equipment, including real estate, etc	1,205,770	317,614	279.6
Cash and current assets, including supplies	9,171,427	32,196,456	—71.5
Profit and loss deficit	.....	444,827	.....
Liabilities, total	10,377,197	32,958,897	—68.5
Capital stock	9,602,570	32,676,242	—70.6
Floating debt and mortgages	18,483	37,145	50.2
Accounts payable	583,160	245,510	137.5
Profit and loss surplus	172,984	.....	.....
Capitalization:			
Capital stock outstanding, par value	9,602,570	32,676,242	—70.6
Employees and salaries and wages:			
Average number	958	176	444.3
Salaries and wages	$393,606	$81,771	381.4

OCEAN CABLE SYSTEMS

	1912	1907	Per Cent of Increase, 1907-1912
Number of companies or systems	7	7	.....
Nautical miles of ocean cable	67,676	46,301	46.2
Number of messages	5,841,280	5,869,317	—0.5
Income, total	$8,469,374	$7,671,700	10.4
Telegraph traffic	8,065,798	7,338,280	9.9
All other sources	403,576	333,420	21.0
Net income	2,952,847	4,079,074	—26.7
Expenses, total	5,516,527	3,642,626	51.4
General operation and maintenance, including salaries, wages and legal expenses	4,008,218	2,204,939	81.8
Interest and taxes	1,214,554	1,190,308	2.0
All other expenses	293,755	247,379	18.7
Balance sheet:			
Assets, total	107,583,155	95,624,892	12.5
Construction and equipment, including real estate, etc	78,136,115	77,438,339	0.9
Stocks and bonds of other companies, treasury stock and "other permanent investments"	16,811,087	12,971,564	29.6
Cash and current assets, including supplies	12,635,953	5,214,989	142.3
Liabilities, total	107,583,155	95,624,892	12.5
Capital stock	55,489,400	52,800,000	5.1
Funded debt and reserves	43,549,451	36,561,391	19.1
Accounts payable	1,459,797	314,955	363.5
Dividends due and sundries	587,229	2,452,351	139.5
Profit and loss surplus	6,497,278	3,496,195	85.8
Capitalization:			
Capital stock outstanding, par value	55,489,400	52,800,000	5.1
Dividends on stock	3,040,200	2,533,041	20.0
Employees and salaries and wages:			
Average number	1,656	1,207	37.2
Salaries and wages	$1,167,014	$915,083	27.5

decade, the increase in nautical miles of cable was 21,375, or 46.2 per cent. The increase in profit and loss surplus was $3,001,083, or 85.8 per cent. Reserves were increased very largely, but the total cannot be shown separately as it is practically that of one system. Capital stock outstanding was $2,689,400, or 5.1 per cent, greater in 1912 than in 1907. The number of wage earners increased 37.2 per cent, and salaries 27.5 per cent. The net income shows a decrease of $1,076,-

TELEGRAPH SYSTEMS

	1912	1907	Per Cent of Increase, 1907-1912
Number of companies or systems	22	20	10.0
Miles of pole line	247,528	239,646	3.3
Miles of single wire owned and leased	1,814,196	1,577,961	15.0
Number of messages	103,536,418	97,924,759	5.7
Number of telegraph offices	30,781	29,056	5.9
Income, total	$56,293,469	$43,912,168	28.2
Telegraph traffic	52,337,211	37,916,907	38.0
All other sources	3,956,258	5,995,261	—34.0
Net income for the year	3,431,044	5,675,181	—39.5
Expenses, total	52,862,425	38,236,987	38.2
General operation and maintenance	39,067,011	31,852,359	22.6
Interest and taxes	2,740,827	2,246,382	22.0
All other expenses	11,054,587	4,138,246	167.1
Balance sheet:			
Assets, total	191,516,700	166,530,835	15.0
Construction and equipment, including real estate, etc	143,910,631	132,607,620	8.5
Stocks and bonds, including other permanent investments and treasury stock	17,122,592	23,514,882	—27.2
Cash and current assets, including supplies and sundries	29,672,528	10,060,505	179.8
Profit and loss deficit	810,949	347,828	133.1
Liabilities, total	191,516,700	166,530,835	15.0
Capital stock	104,274,435	102,289,575	1.9
Funded debt	34,741,000	37,204,000	—6.6
Reserves	5,254,329	1,876,858	180.0
Accounts payable	12,175,438	7,894,978	54.2
Dividends, taxes and interest due and accrued	1,460,733	.....	.....
Sundries	23,447,146	87,852	.....
Profit and loss surplus	10,163,619	17,177,572	—40.8
Net surplus	9,352,670	16,829,744	—44.4
Capitalization:			
Capital stock outstanding, par value	104,274,435	102,289,575	1.9
Dividends on stock	3,139,861	4,944,042	—36.5
Funded debt	34,741,000	37,204,000	—6.6
Employees and salaries and wages:			
Average number	35,639	26,827	32.8
Salaries and wages	$23,797,980	$16,893,166	40.9

227, or 26.7 per cent, caused by increase in cost of operation and maintenance amounting to $1,803,279.

Wireless Telegraph Systems

The figures presented for wireless-telegraph systems show that, while there was a net deficit in operations in 1907, a net income was the result of the business in 1912. The gross income (only the total of which can be given, as to do otherwise would disclose individual financial operations) increased $562,367, or 527 per cent, over 1907. A great part of this income came from the rental of wireless apparatus for ship equipment. The great decrease in assets—$22,581,700, or 68.5 per cent—is due to the disappearance of one large company in a merger of interests. The decrease was largely in the value placed on patent rights, good will and contracts in 1907, and on treasury stock.

Land Telegraph Systems

Of the land telegraph systems all except one (a Canadian company) are operated by companies incorporated in the United States. During the semi-decade covered by the figures shown the number of companies increased by two. The miles of single wire increased by 236,235, and the number of offices was increased 1725. While the gross income increased $12,381,301, the expenses of all kinds increased by a greater amount, $14,625,438. The net income by this showing was therefore reduced $2,244,137. The increase in construction and equipment account appears as $11,303,-011, but the amount reported for stocks and bonds and other permanent investments decreased $6,392,290. There was an increase of $19,612,023 in cash and current assets. Capital stock outstanding increased $1,-984,860, and the funded debt decreased $2,463,000. There was a notable increase of $3,377,471 in reserves.

Water-Power from Green River for Kentucky Coal Mines

The du Ponts of Wilmington, Del., who are largely interested in coal-mining operations in western Kentucky, are reported to be back of a plan for the construction of a large power plant on Green River, near Central City, Ky., which will be used to furnish energy for the operation of more than thirty coal mines in that section. Gen. T. C. du Pont was recently in Central City looking over the situation, following which detailed plans for the work were announced. A company capitalized at $300,000, to be known as the Central City, Drakesboro & Greenville Railway Company, will be incorporated first, for the purpose of building a traction line connecting the towns named. This line will be supplied with energy from the proposed power plant on Green River.

The plan is of special interest on account of the fact that a merger of the leading coal-mining interests in western Kentucky is now being planned, indicating that it will be a comparatively easy matter to secure the business of the coal operators. Central power plants for the important coal sections of eastern Kentucky are also in prospect.

"Home-Rule" Question in Chicago

At the April 7 election voters in Chicago will express themselves on the public-policy question "Should the Legislature amend the public utilities act so as to give Chicago home rule over its public utilities?" The question was discussed at the City Club on Feb. 21. Mr. S. S. Gregory, a prominent lawyer, said that there is no more reason why there should be a separate commission for Chicago than there is why there should be a separate Supreme Court. If efficiency is wanted, there must be centralization of power. Mr. Edward W. Bemis, public utility expert, presented the arguments for home rule. He contended that the local rates of monopolies, like local taxation, should be fixed locally as far as possible. The important questions of public policy involved in utility regulation should be decided by the people, and not by a commission. Mr. F. S. Munro, a member of the Legislature, said that local officers, like mayor and aldermen, would never have the strength to raise a rate, no matter how equitable such an increase might be. Mr. James G. Skinner, assistant corporation counsel, who drafted the home-rule article of the original bill, declared that the City Council of Chicago is a more efficient working body than the Illinois Legislature of 1913.

Engineers in Public

Mr. Henry Matson Waite, city manager of Dayton, Ohio, in the course of an interesting talk on "The City as a Business Proposition" at the fiftieth anniversary convention of the Theta Xi Fraternity, New York City, on Feb. 21, urged the necessity for training the young engineer, as a part of his regular college course, in the art of being able to rise to his feet and explain in simple language arguments, conclusions and opinions resulting from his professional work in such logical, orderly and

convincing manner as to compel attention and secure prompt action from his hearers. The present trend of all engineering work makes it vitally important that the engineer have at least a modicum of skill in public speaking. This is equally true whether the audience be a board of directors or a meeting of citizens. In the past, Mr. Waite contended, the very nature of the engineer's professional work caused him to shun publicity and compelled him to confine his ability within a written report which, after it left his hands, he had no means of defending, amplifying or even correcting. Just now, however, a new era of engineering is opening up, in which even the keenest specialist must take a broader view of his field than ever before and, in many instances, is obliged to elucidate his points for the benefit of non-technical people. In other words, the engineer of to-day finds it a valuable asset to have a round view of engineering as a whole and the ability to explain professional matters in simple, non-technical language.

State and Federal Franchise for Water-Power Proposed

Following a session of President Wilson's Cabinet with him last week, at which was threshed out the proposed water-power policy of the administration, Secretary of War Garrison has sent to Representative Adamson, chairman of the House committee on commerce, a long letter outlining his views as to what legislation should be passed by the present Congress in relation to water-power.

Secretary Garrison also sent to Representative Adamson a copy of a bill proposed by the War Department, with the approval of the President, but it is understood in Washington that this bill does not contain the proposition advanced in Secretary Garrison's letter that power plants shall be turned over to the State in which they are situated after private owners have enjoyed them for the suggested privilege period of fifty years.

Representative Adamson declines to make public a copy of Secretary Garrison's proposed bill until his sub-committee has had an opportunity to pass on it. He is of the opinion that there is not wide divergence of opinion between the members of his sub-committee on water-power and the Secretary of War. Friends of Mr. Adamson, however, who are acquainted with the water-power resources of his State as well as those of the states from which the other members of the sub-committee come are of the opinion that there is not the least chance that the committee on commerce will insert in any bill it brings in a paragraph permitting or requiring water-power plants to go into the possession of the states after their owners and builders have enjoyed them for the proposed period of fifty years.

The sub-committee, which has been working on water-power legislation for a year, it is expected, will soon have hearings on the various bills proposed, when all interested persons will probably have an opportunity to state their views. The final legislation, Representative Adamson states, will be as an amendment to the general dam act, and it will surely be passed at this Congress.

In writing to Representative Adamson, Secretary Garrison proposes that only public utility corporations shall be permitted to dam a navigable stream and create water-power for hydroelectric uses, and must obtain the right first from the State and then from Congress. Such companies in doing so must be subject to all the laws and regulations of the State for the control of public utilities corporations, while the State in which water-power development is sought must, before the consent of Congress can be obtained, provide these laws.

The bill contains sections to safeguard the public by duplicating the right of control, so that the federal government may be appealed to by citizens who believe they are not justly dealt with by the public utilities corporation using a water-power.

The taxation features of the proposed control of water-power are left to the State, and the suggestion is made that after a certain period of years the water-power revert to the State. In this event it is proposed that the State enter into the position occupied by the corporation, and that the federal right of supervision remain as to the State.

"It seemed to me that the proper point of view from which to approach a situation which had reached what appeared to be a permanent standstill," Mr. Garrison said in his letter, "was to consider not only the law but also the equities and interests of all concerned, so as to decide upon a policy consonant with law and with the equities and interests aforesaid.

"Legally speaking, I do not think there can be any dispute that, with respect to the question of power, the position of the federal government is paramount.

"Therefore, the proper solution seems to me to be to adopt a policy which recognizes the equitable sphere of each of those in interest. I conceive the equitable sphere of the federal government to be to see to it that this great public utility, wherever availed of, shall be availed of in a way that will benefit the greatest number under the most favorable terms possible; and in doing so, to recognize the justice (not as a matter of law) of the State entity or sovereignty receiving a revenue from the operation of this public utility within its confines and regulating it for the benefit of its people."

Elements of a Street-Lighting Contract

Mr. Sylvester B. Way, vice-president Milwaukee Electric Railway & Light Company, read a paper recently before the Milwaukee Electric League on "Elements of a Street-Lighting Contract." Starting with the premise that the best type of franchise is one providing for indeterminate duration but giving to the municipality or the State the right to recapture or own the utility at any time it so desires, Mr. Way said that it is evident that the ideal form of street-lighting contract would be one having no definite term. Such a contract, however, should provide for the supply of street-lighting service at cost and for an indefinite period or until such time as the municipality desires to terminate the contract. The condition of termination, where service has been rendered at cost, would necessarily be that the municipality would be required to take over at its then present value the special investment made by the utility for the purpose of carrying out the contract, or otherwise compensate the utility for the remaining value rendered useless to the utility by the termination of the contract. This ideal condition, however, cannot be realized in Wisconsin as the statutes of that State limit the term for which a municipality can execute a street-lighting contract to a period not longer than ten years. Mr. Way quoted from the report made by the Railroad Commission of Wisconsin to the street-lighting committee of the City Council of Milwaukee, which was described in the issues of the *Electrical World* for Sept. 20 and 27, 1913.

Under the Wisconsin law and commission the matter of arriving at equitable charges for public utility service has been simplified. No contract can be entered into between a municipality and a utility that will not be

subject to review by the commission at any time. The value of the property devoted to the particular service is appraised and the usual allowances for interest, depreciation and taxes are determined, and from this analysis and a determination of the reasonable and necessary operating expenses the cost of the service is computed. The item of depreciation constitutes a relatively large proportion of the total cost of service, and if the term of the contract is less than the natural or useful life of the special equipment required for street-lighting purposes the difference between the rate of depreciation corresponding to the natural life of such equipment and the actual life, as determined by the term of the contract, must be allowed as special depreciation or amortization.

If the price to be included in any street-lighting contract is to be based upon cost analysis, all uncertain elements entering into the determination of the cost must be eliminated. With a definite specification as to the number and type of lamps to be used and their location and the term of the contract made definite or indeterminate, the cost of the service can be predicted with a high degree of accuracy.

Mr. Way described in detail the principal elements entering into a contract which would be so constructed as to eliminate all uncertainties to the greatest possible extent and would permit, therefore, a rate to be calculated upon the cost of service basis and at the same time would permit the municipality the widest latitude in keeping its system modern, in changing the location or character of service supplied to lamps, and eliminate the tendency to avoid the installation of needed additional lamps during the last years of the contract.

Electric-Vehicle Tires

At the meeting of the Electric Vehicle Association of America held at New York, Feb. 4, Mr. F. E. Whitney, of the Commercial Truck Company, Philadelphia, Pa., presented in revised form his paper on "The Tire Question as Applied to Electric Vehicles," which had been previously read before the Chicago convention of the association last fall.

The recent rapid rise in popularity of the electric vehicle, said the speaker, has been due to the fitness of this type of car for city work and to marked improvements in such essential features as ball and roller bearings, batteries with largely increased capacity and reduced weight, reduced maintenance costs, reduced cost of electricity and increase in number of charging stations, better and more efficient motors and types of gearing, and, last but not least, greatly increased tire life and, in addition, increased effective quality of the rubber.

A well-designed truck with good tires will show an energy consumption of, say, 35 watt-hr. per 1000-lb.-mile, and of this total from 20 watt-hr. to 25 watt-hr. are absorbed in the tires alone, leaving the remaining 15 watt-hr. to 20 watt-hr. distributed between bearings, gearing, motor loss, windage, etc. A change in tires on this same truck might easily increase the energy consumption to 50 watt-hr. per 1000-lb.-mile, or in comparison in miles on one charge of the battery the truck in the first case would cover, say, 50 miles on one charge of the battery, as against 35 miles in the second case.

The several methods of testing tires which have been found most satisfactory by the author are as follows:

1. The bounce test, which consists in dropping a piece of hard material on the tire from a definite height and measuring the height it will rebound. The proportion of the rebound to the total height represents the efficiency of the tire. Although this is only a comparative test, the results secured are reasonably accurate.

2. The coasting test, in which the vehicle is allowed to coast down a known grade, the distance it will run being determined. The more efficient tire will coast farther.

3. The running test, which is made by running the vehicle over a measured course. With proper instruments and stop-watch, the energy consumed is measured in terms of watt-hours per ton or 1000-lb.-mile.

4. The towing test, with traction dynamometer. This test consists in towing the vehicle over a definite course in both directions and observing the drawbar pull required.

5. The dynamometer test, in which the tire is rolled against a steel-tired wheel.

New York State Electrical Companies on Conservation

A meeting of representatives of electrical companies of New York State was held at the Hotel Ten Eyck, Albany, N. Y., on Feb. 21, to discuss pending water-power legislation. The meeting was called by the Empire State Gas and Electric Association. Mr. J. T. Hutchings, Rochester, president of the association, presided. Mr. Charles H. B. Chapin was secretary. Fifty companies were represented, and practically every one present spoke on the subject. A resolution was adopted expressing the unanimous support by the meeting of the action of the executive committee of the Empire State association on water-power matters. Mr. Chapin read the tentative text of bulletins which the association is to issue to companies in New York State.

Resolutions were adopted for presentation to Governor Glynn calling attention to the platform of the association, which is substantially the same as the declaration of principles adopted by the National Conservation Congress which met in Washington recently. The preamble to the resolutions declares that conservation of natural resources, especially of water resources, is essential to the continued prosperity and pre-eminence of the State and that true conservation of water resources means proper and economic use, with a view not only to present needs but also to future needs. The resolution therefore expresses the opinion of the company representatives, as practical men of long experience in the generation of electrical energy from coal and from water-power and in the transmission, distribution and sale of such energy, and as citizens and taxpayers, that the declaration of principles mentioned, if adopted as the basis of a plan, will accomplish the purposes desired in the most satisfactory manner possible and with the greatest benefit to the State as a whole.

The Empire State association, through Mr. Chapin as secretary, has issued a circular letter to electric light and power companies in the State giving a brief outline of the so-called Velte-Smith hydroelectric bills now pending in the Legislature. A joint hearing on these bills will be held in the Assembly Chamber at Albany at 2 p. m. on March 3. This letter is in part as follows:

"These bills, if enacted into law, would, under the guise of conservation of natural resources, commit the State to a policy of duplicating present investment and entering into direct competition with private capital. This general policy, we firmly believe, would be disastrous to the pre-eminence of the State and the welfare of the people, and in its special application to the electric light and power business would mean a decrease in efficiency of operation, a falling off in the quality of service to consumers, less assurance of a reasonable

return upon capital invested, and consequently more difficulty in securing the new capital necessary for extensions and improvements.

"In addition to this, the expense of the project to the State and municipalities would be enormous and the success very doubtful. It would open up another and tremendously large field for the kind of extravagance and mismanagement with which we are becoming familiar through the investigations now being made. It would constitute another means for dealing out political patronage.

"The matter is not local to any community or to any section of the State, as some have seemed to assume. It is State-wide in character and in effect. We are convinced that the project will be defeated once and for all time if full publicity can be given to the facts, as we are sure the people of New York State will not countenance such a proposition for one minute if they are shown its true import. The only thing we are asking you or any one else to do is to tell the truth about it just as often as you can and to as many people as you can get to listen to it.

"Talk to your representatives in the Legislature, to the editors of your local papers, to the people you meet at home and in business, and point out to them the cost of carrying out the project—probably from $200,000,000 to $500,000,000 of public money. Show them the opportunities that this will afford for extravagance, graft and scandal.

"See your local bankers and tell them of the $200,000,000 of State bonds and an equal amount of municipal bonds and ask them what effect this will have on the State's credit and on the value of the State and municipal bonds they are holding as a reserve. You well know the risks of the light and power business due to changes in methods or improvements in the art. Point these out to the bankers, because in adopting this proposed policy the State will be going into the business and will have to assume these risks.

"Get in touch with your directors and stockholders and explain the situation to them. We know that if they understand the matter they will be glad to assist you in giving publicity to the facts. Tell your employees about it and ask them to give the facts to their friends and acquaintances."

Hearing at Washington on Niagara Power

The committee on foreign affairs of the House of Representatives heard testimony from Governor Glynn and other members of a New York delegation in Washington on Feb. 9 concerning the Niagara Falls power bills now before the committee. The committee is expecting to receive a brief from Chairman Van Kennen of the New York Conservation Commission. It has been agreed that the brief shall formally outline the whole position of New York State in the matter. In the delegation which appeared before the committee were, in addition to Governor Glynn, the Attorney General of New York, Mr. Thomas Carmody; Senator H. P. Velte, of the New York State Legislature; Mr. Van Kennen, of the New York Conservation Commission; Mr. Malone, of the New York Power Commission, and Mr. Charles A. Towne, former United States Senator and former member of the House of Representatives, now special counsel for New York State in Niagara Falls power bills matters.

The delegation announced definite opposition to the Cline bill, although an adjournment had been taken at the last hearing of the committee to enable the representatives of New York to suggest amendments to that bill. Instead, it was announced that the New York State government is now solidly lined behind the Levy bill.

Senator Velte, the first speaker at the hearing, said that the delegation was opposed to the Cline bill for the reason that it does not seem to be able to determine whether or not the bill usurps the right which the State of New York claims it has in Niagara Falls. A question had been asked as to the position of the State of New York on the question of diversion of the waters, as to the position the State would take in converting them into power. Senator Velte said he had introduced a bill in the New York Legislature which definitely sets forth the position of the State, and if it becomes a law it will give all the rights of water-power to the people of the State.

Attorney General Carmody said that the federal government has the right to control the diversion of water from Niagara River for one purpose only, and that is in the interest of navigation. New York State concedes the right of the federal government to preserve Niagara River, so far as its commerce is concerned, but when that right has been exercised the function of the federal government ceases.

Continuing, Mr. Carmody said that the property in the river, in the water as well as in the bed of the river, belongs to the State of New York. He said he would like to find out from the committee whether the proposition is challenged that the federal government has no right to control the diversion of water from Niagara River, except in the interest of navigation, or if that question is involved for the purpose of preserving the stream as a boundary stream for national defense.

Mr. Carmody was then told that he had about stated the ground upon which the committee has passed upon the bill.

Mr. Carmody replied that he started with the assumption that the treaty adopted and ratified between this country and Great Britain that permits the diversion of 20,000 cu. ft. of water per second is based upon the navigability and the integrity of the stream for military defense. That question was fully investigated before the treaty was ratified, and it seems to have been conceded that 20,000 cu. ft. of water per second could be diverted from the Niagara River without interfering with the navigability of the stream.

Whether that be so or not, if Congress finds that the navigability of the stream is interfered with by reason of that or any other diversion, Congress may prevent the diversion for the purpose of preserving the stream and Mr. Carmody said he wished to have it distinctly understood that he does not dispute the right of Congress to say how much may be diverted. But when the committee determines the amount of water which may be diverted the property rights of the State of New York are invoked and asserted, and the State has the right to determine the rules and regulations under which that diversion may be enjoyed.

The interest of navigation does not require that Congress should say who shall enjoy the privilege to be enjoyed or the circumstances under which that privilege shall be enjoyed. What will the courts say when trouble arises hereafter, possibly between the State of New York and those to whom the federal government has given permits?

Mr. Carmody then said that what Congress should do is to provide, under the supervision of the Secretary of War, for permits to the State of New York or to such parties as the State may designate as the parties to enjoy what diversion may be permitted, subject to the navigability of the stream or to its preservation for military defense.

When Governor Glynn testified Representative Cline

asked him how long it had been since the State of New York gave away 1,000,000 hp at Long Sioux.

Governor Glynn said that the Republicans did that, not the Democrats, and that it would be repealed.

Representative Cline then asked about the bill before the Assembly to limit the provisions in the charters to companies having power rights on the Niagara River.

Governor Glynn said that the bill is pending and will undoubtedly be passed by a Democratic Senate. There are also five other bills which he thinks will match, so far as the securing of true conservation is concerned, any bills ever introduced in Congress by anybody.

Governor Glynn added that he would have the State itself develop every drop of water in the State and sell the power to the people at the cost of production. He would do what Canada is doing.

Governor Glynn added that he wished to dispel the apparent delusion to the effect that the representatives of New York State were there to make war on the power companies at Niagara. Confiscation is not in anyone's thought. He has no desire to do the power companies a wrong but does want to have New York State have control of its water.

Mr. Towne also made an extended argument.

Applications of Electricity in Mines

The American Institute of Mining Engineers, which held its one hundred and seventieth annual meeting in New York City, Feb. 16 to 19 inclusive, devoted the afternoon session of Feb. 17 almost entirely to talks and discussions relating to the application of electricity in mines.

Safeguarding Mine Installations

Mr. H. H. Clark, of Chicago, in his paper on "Safeguarding the Use of Electricity in Mines," said that it is more important to guard against the installation of poorly insulated wires in mines than elsewhere because the dim light usually available there increases the hazard of contact with live wires. The possibility of conductors becoming grounded is also augmented by mine conditions, increasing the danger of shocks or accidental explosions. Explosives, gas or coal dust may be accidentally ignited if exposed electrical conductors are employed or if circuits become grounded. Some very mysterious accidents have been caused by hauling explosives in metallic packages and by sparks from trolley wires coming in contact with exposed explosives. The speaker advised against employing the earth as one conductor of a detonating circuit, as sufficient potential difference may exist between neighboring earth strata to ignite a charge prematurely. Investigation by the United States Bureau of Mines shows that large sizes of carbon lamps and tungsten lamps of 25 watts rating or above are almost certain to ignite inflammable gases when the bulbs are broken. Several general suggestions were made on equipment to be used in mines, and the method of installing it to prevent accidents, but Mr. Clark declared that a code of rules is needed in mines which will be as effective as are the Fire Underwriters' requirements on the surface. Among electrical devices which have made for safer mine operation are the telephone, electrical shot-firing devices, storage-battery locomotives and portable electric mine lamps. The day will come, said the author, when electricity, instead of being considered a menace in mines, will be regarded as a means of safeguarding life and property.

A similar paper on "The Safety of Underground Electrical Installations," by Mr. C. M. Means, Pittsburgh, Pa., was abstracted by Mr. William Kelly, chairman of the electrical section. He called attention to statistics showing that electricity is responsible for only a small percentage of the mine accidents. The paper bore out Mr. Clark's statements that the proper use of electricity in mines will decrease the hazard rather than increase it. As the competent men who are trained in electrical work on the surface do not usually care to confine themselves underground, it is necessary to recruit men for electrical work from among the mine workers. These men should therefore have an opportunity to perfect themselves as electricians through some educational bureau maintained by the mining company. The need of competent mine inspectors and of wiring rules applicable to mines was also emphasized. The author of the paper recommended the concerted action of all interested in the extensive use of electrical apparatus in compiling a suitable set of rules.

A discussion followed the delivery of these two papers in which Messrs. G. S. Rice, New York; E. G. Spilsbury, New York, and B. F. Tillson, Franklin Furnace, N. J., took part.

Mr. Rice declared that English statistics show that 90 per cent of mine accidents, other than the falling of roofs, result from explosions caused by open lamps. He believes the use of electricity increases hazards, but mines cannot be operated economically without this form of energy. Faulty insulation was cited as another cause of accidents in mines. Tests made by the United States Bureau of Mines show that the inflammability of coal dust is generally proportional to the pound-Fahrenheit units contained per pound of coal.

In answer to Mr. Spilsbury's question regarding the weight of portable electric mine lamps and the improvements that have been made in them, Mr. Clark said that 35-lb. brass-inclosed storage-battery lamps are now on the market, the battery of which can be hung on the miner's belt and the lamp attached to his cap.

Mr. Tillson briefly described a light primary-battery lamp which is being used satisfactorily in some mines. The plate electrodes are replaced only once each shift.

Application of Electricity in Mines

Instead of reading his paper on "The Application of Electric Motors to Shovels," Mr. H. W. Rogers gave an illustrated talk on the equipment of motor-driven excavators, and explained some of the characteristic curves of motors most suited to operate them. He recommended the use of series direct-current motors in all cases, because the control is simpler, the size of the motor is minimized, and its characteristics meet the requirements of excavating operations better than those of an alternating-current motor. When only alternating-current energy is available, motor-generators should be employed to furnish the direct current. Two small motors should be used instead of one large machine for hoisting the scoop, as the power required for accelerating is less than that for the thrust. Electric shovels eliminate the employment of three men, teaming for one-half day, use of water, and considerable waste which accompanies the operation of a steam shovel. Comparative estimates were made to show the cost of operating a 120-ton shovel with steam and electricity. Excavating an average of 2500 cu. yd. per day of ten hours, the total cost per day of one shift operating with steam is $48.14, with direct current $42.75 and with alternating current $51.38. With three shifts per day figures favor direct-current drive still more.

Mr. Spilsbury and Mr. F. H. Armstrong, of Vulcan, Mich., took part in the discussion which followed.

Mr. Spilsbury asked whether equipping motors with flywheels would not enable them to carry the peak loads of excavating, to which Mr. Rogers replied that space is not available and that such a system is too expensive, as the power must be divided among more units.

Mr. Armstrong briefly described a new combined electric-hydraulic shovel which will soon be put in operation at the Penn and Republic iron mines in Michigan. Water for operating this shovel is delivered to a pressure tank at 250 lb. pressure by a motor-driven centrifugal pump. The water is used to operate plunger pistons connected to the hoisting, thrust and swinging apparatus.

Recent Developments in Electric Mine Machinery

A paper on "Recent Developments in the Design of Electric Locomotives and Coal-Cutting Machines," by Mr. Sanford B. Belden, Columbus, Ohio, was read in brief by Mr. R. R. Dunlop. A rating of 10 hp per ton hauled was recommended for mine locomotives operating at 6 miles per hour in ordinary cases. In specifying the temperature rise allowable on mine locomotives the author said he believed that the temperature of the commutator should be included, as the latter is usually cramped for space on narrow-gage roads. The use of ball bearings on locomotives will prevent armatures rubbing on the pole pieces, which usually happens if ordinary bushed bearings become worn. Interpoles on

ELECTRICALLY OPERATED COMBINATION MINING AND LOADING MACHINE

mine locomotives are not considered necessary by the author, as the wheels will slip if the motors are overloaded, hence commutation at normal loads is all that need be provided for. Locomotives should be designed so that motor casings may be removed without disturbing pinions or gear cases, and journal boxes should be arranged for rapid removal of wheels and axes. New types of "gathering" locomotives, coal-cutting, long and short wall, and top-cutting, breast-cutting, turret-mining and mechanical-loading machines were described. A motor-driven combined cutting and loading machine spoken of by Mr. Dunlop will be described in a later issue of the *Electrical World*.

Owing to the lack of time and the absence of Mr. Charles Legrand, his paper on "Electric Traction in Mines," relating to the electrical equipment of copper mines in Douglas, Ariz., was not read. It called attention to the necessity of protecting trolley wires from dripping acidified water. In one case No. 00 wire was cut in two in three weeks by a small drip. Bad track bonding was cited as a cause of commutator trouble, as it may produce a sudden rush of current after a wheel passes over a rail joint, which will result in a ring of fire around the commutator. Figures were given on the cost of operating trolley and storage-battery locomotives. At one mine a 3-ton storage-battery locomotive, driven by 150 Edison cells mounted on a trailer, required 1.6 kw-hr. per useful ton-mile, under the worst conditions as regards tracks and curves. At the same mine trolley locomotives equipped with ball bearings required 875 watt-hr. at the switchboard per useful ton-mile. During 1912 408,000 ton-miles of work were performed by electric locomotives at a total cost, including maintenance and power, of 15.07 cents per useful ton-mile.

Electrical Equipment of Mines

An interesting paper on the electrical equipment and operating cost of some iron mines at Mineville, N. Y., was read by Mr. Solomon Le Fevre. Electricity is used here for practically every operation, including mining, hoisting, crushing, separating, etc. Motor-driven hoists, showing a total saving of 5 cents per ton over the steam-operated units, are employed.

The "Use of Electricity at the Penn and Republic Iron Mines, Michigan," was described at length in a paper so entitled by Messrs. William Kelly and F. H. Armstrong, of Vulcan, Mich. The pumping equipment, hoisting apparatus, tram system and signaling devices and the hydroelectric plant supplying the energy were described. Results of tests on the equipment, together with methods of operating and descriptions of safety devices, were also included in the paper.

In the discussion of this paper Messrs. K. A. Pauly, Armstrong, Tillson and J. E. Johnson, Ashland, Wis., took part.

In answer to Mr. Pauly's question regarding the range of motor slip which can be obtained with the water rheostat used at the Penn and Republic mines, Mr. Armstrong said that from 6 per cent to 20 per cent could be secured, although only 7 to 8 per cent is normally required.

Mr. Johnson expressed doubt as to the higher efficiency of electric hoists as compared with the air type. Mr. Pauly asserted that the efficiency of air hoists in certain Montana mines does not exceed 29 per cent, while the manufacturers claim that the units develop 50 per cent. He added that more trouble arises in the air end of a motor-driven compressor than in the electrical apparatus, to which statement Mr. Johnson and others took exception.

Electric Drilling

The extensive use of electric air drills on one particular job was brought out in a paper entitled "Drilling Performances at the Kensico Dam, Catskill Aqueduct System, New York," by Mr. W. L. Saunders, New York City. On this eight-million-dollar job of constructing a 29,000,000,000-gal. reservoir it was found that $75,000 could be saved by employing electric air drills rather than other types.

Portable motor-driven pulsators were used to operate the drills which bored holes in flawless gneiss to a maximum depth of 22 ft. and a diameter of 1.75 in. Including the time required for all drilling operations at the quarry supplying stone for this dam, a hole 31 ft. deep could be drilled in 448 minutes, the average spacing of holes being from 17.5 ft. to 16 ft. The total drilling cost per linear foot was 21.48 cents, including energy and labor. At the dam pit one of the drills accomplished an average of 26.4 linear ft. in 236 minutes 10 seconds.

The drilling apparatus, weighing 800 lb., consisted of two units—an air drill and a motor-driven pulsator connected by two lengths of rubber hose which served as a closed circuit for the air, which is used over and over. The pulsator is geared to a small alternating-current motor mounted rigidly on a truck and receiving energy through a flexible cable.

Midwinter Convention, A. I. E. E.

The second annual midwinter meeting of the American Institute of Electrical Engineers at New York, Feb. 25 to 27, was opened with an introductory address by President C. O. Mailloux, who referred to the international beneficial effects resulting from last year's discussion on ratings of electrical machinery. The new administration hopes to produce equally desirable results this year, he said, through the new arrangement of committees and the reclassification of their duties. Mr. Mailloux especially commended Mr. D. B. Rushmore for the energy and effort put into the activities of the electric power committee, of which he is chairman. The entire convention was held under the auspices of this committee, each of the six technical sessions being devoted to subjects of one of the electric power committee's sub-committees.

Mr. Rushmore spoke next on the development of the electrical industry and declared that the American Institute of Electrical Engineers will soon have to serve as a conference for electrical specialists rather than for general engineers, so that developments in the methods of conducting the Institute's conventions similar to those now being instituted must be made continually. The value of this institution has increased as "the time has come," said the speaker, "when the engineer who knows and does can shake off the inefficient engineer who dominates and borders on his work." Mr. Rushmore attributed the effectiveness of the American Institute of Electrical Engineers to the vim of the younger generation represented and to the freedom and initiative allowed the individual members in discussions through the application of the president's broad policy. The readjustment of the duties of the committees and their subdivision into sub-committees is proving effective, which indicates that further subdivisions may induce others to join the Institute who have not been attracted before. The speaker expressed belief that the scope of the electric power committee's duties do and should lie almost entirely in the public utility field. In concluding his remarks, Mr. Rushmore showed some interesting curves, indicating the rate of increase in the production of electrical apparatus, the extensive use of electrical energy, and the increased production of oil, coal, copper, aluminum and electrical apparatus. He predicted that motors will in the future probably be used to a greater extent for mine hoisting than ever before, since the results of electrically operated mines show motor drive to be more simple and efficient in operation, as well as lower in operating cost, than other motive powers. A new era is approaching in the development of electrical apparatus which will result in the elimination of manual operations almost entirely, and the dependence of the public on the generation of electrical energy will be enormous.

Mr. P. H. Thomas, New York, chairman, next submitted the report of the engineering data sub-committee, and was followed by Dr. Harold Pender, Boston, Mass., who read the report of the handbook sub-committee on "The Feasibility of an A. I. E. E. Handbook."

Engineering Data and Handbook

The report of the sub-committee on engineering data outlined the sub-committee's plans for its future work in the collection of engineering information. In this function the work of the sub-committee has been an outgrowth of the former activities of the high-tension transmission committee, but with extended scope. The engineering data which the sub-committee proposes to compile will be of two classes: (1) information of an exact character, the correctness of which is universally conceded, and (2) information as to forms of construction or elements of design which have been used by various individuals in solving frequently recurring problems, the conditions of which are well understood by engineers in general. Such information will usually be useful to an engineer who has a similar problem to solve. In this class is information on water-turbine performance, steam-condenser operation, transmission-line construction, overhead-trolley design, use of measuring instruments, etc.

Other possible subjects are the use of current-limiting reactance coils, the use of synchronous power-factor regulating apparatus, methods of locating grounds in cables, methods of erecting towers in transmission lines, high-tension insulation, electric drive in steel mills, etc.

The handbook sub-committee was created to consider the feasibility of the Institute's compiling a handbook to be issued to its members, and also to present the idea for discussion, in order thereby to determine the feeling of the members at large regarding such a project. There have been a few instances of other technical societies issuing to their members such manuals. The majority of the members of the sub-committee feel, however, that the project of the A. I. E. E. compiling and issuing a handbook of technical data is neither especially desirable nor is it practicable. The suggestion has also been made that if the data regarding electrical engineering facts and methods contained in the *Transactions* could be condensed into small space, the book would be exceedingly valuable. The members of the committee undertook to try this condensation for selected topics, but found the work involved to be enormous. To carry out the work of salaried officers would cost so much that it has not appeared to the members of the committee that the project was feasible. Another suggestion has been that the Institute compile volumes of papers on certain subjects, such as transmission lines, traction, telephony and telegraphy, and the properties of material, as was done several years ago with marked success.

Discussion

Mr. H. F. Thomson, Boston, Mass., secretary of the handbook sub-committee, reported that out of more than twenty engineering societies communicated with only one has itself issued a handbook for the use of its engineering members. Mr. Thomson quoted Mr. T. C. Martin, executive secretary of the National Electric Light Association, as replying that for the Institute to publish a handbook would be simply duplication of work done already and effectively.

The American Society of Mechanical Engineers once considered issuing such a handbook, but deemed its publication not feasible. Mr. C. W. Rice, New York, secretary of the A. S. M. E., reported that he knew of no group of engineers in his own society willing to get up such a publication, and, out of its membership of 5000, had heard of only two persons expressing a desire for such a compilation as that described. He thought it hardly worth while to duplicate existing handbooks.

Mr. H. M. Hobart, Schenectady, N. Y., said that a large number of printed engineering data are out of date, while the most useful material, relatively small in amount, is that which is timely. He suggested that for reference use curves might be reprinted from Institute papers and somewhat elaborated titles given to them which would make their meaning and value available to the reader without other text matter. Out of a given year's Institute papers, also, some 100 pages of selected matter might be compiled for publication, although on account of the great publishing difficulties involved Mr. Hobart advised in general that the Institute encourage activity in the publication of data on the part of others rather than itself undertake the work.

Mr. D. B. Rushmore, Schenectady, N. Y., who pre-

sided at the session, said that the Institute is already engaged in certain publishing work and urged that the principle of co-operative, centralized effort be practically applied to the compilation of handbook material.

Mr. P. M. Lincoln, Pittsburgh, Pa., characterized the idea of an Institute handbook as an excellent one, but he questioned its possibility.

Prof. C. A. Adams, Boston, Mass., declared that the handbooks now available are of small usefulness, taken separately, and all together, he added, they do not contain such good material as should be found in a single non-competitive handbook properly compiled under authoritative direction. However, said Professor Adams, the amount of work necessary to issue such a book would indeed be stupendous, and it would be unjust to demand the time of engineers without remuneration.

Mr. S. Haar, New York, advised that the Institute act as an intermediary in securing the publication of a handbook in a way similar to that by which the Nautical Almanac is published under governmental direction.

Mr. E. J. Henkle, New York, said that no commercial organization can secure such balanced data as those which an engineering organization like the Institute can compile. He commended the Hütte handbook, so familiar to engineers abroad. This, he said, is now in its twenty-first edition and presents the greatest uniformity of contents.

Mr. W. J. Hammer, New York, suggested that each of the sub-committees prepare sheets of data to be sent out to Institute members, in this way making a gradual approach toward the handbook problem.

Mr. C. W. Rice, New York, said that it is perfectly ethical for an engineering organization to publish a handbook if it desires to. The Verein Deutsche Ingenieur remunerates its authors and also subsidizes investigations, but it is not likely, said Mr. Rice, that any American society will be able to pay its authors.

In closing the discussion, President Mailloux expressed his belief that the Institute should not compete with publishing houses in the publication of a handbook, but should rather complement their efforts. It is the published material of the Institute which has made it great, he declared, and the broadest possible publicity should be given to its proceedings. In this direction, for example, the Italian Society of Electrical Engineers prints short abstracts of its principal papers in French, so that the information therein contained may be made available to the entire engineering world.

Five papers were presented at the power-station session of Wednesday afternoon.

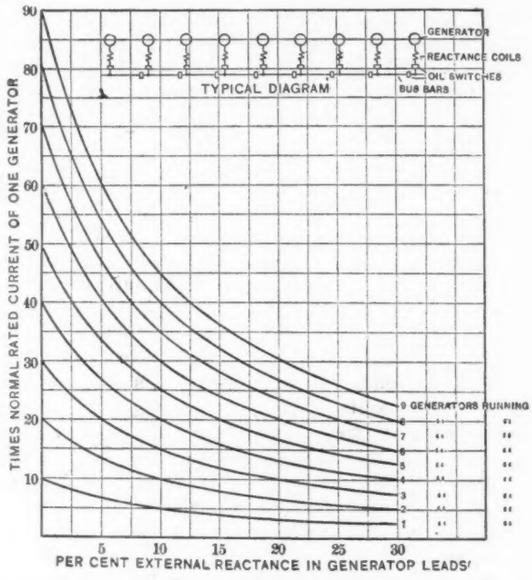
Protective Reactances in Large Power Stations

In a paper by Messrs. James Lyman, Allen M. Rossman and Leslie L. Perry, it was stated that the present tendency in power generation is toward larger central stations and larger units, resulting in the concentration of large amounts of power on single sets of busbars and consequently requiring protection against excessive flows of current into accidental faults. Reactance coils can be used in various ways to limit instantaneous current flows. Reactance coils in the generator leads, while limiting the flow of current from the different generators, are not, however, efficient for limiting the current flow into a fault. The accompanying illustration shows the relation between per cent reactance in the generator leads and the short-circuit current on the busbars for different assumed values of reactances, with one to nine generators connected to the buses. Thus it is seen that the first few per cent of reactance added are much more effective in reducing the short-circuit current than are subsequent additions. With nine 25,000-kva units in operation, each requires 20 per cent reactance in its leads, a total of 45,000 kva, to limit the current flow to thirty times the rated current of one generator.

Bus reactances are less bulky and less expensive than generator reactances, are more efficient in controlling the current flow, and have the advantage of localizing the effect of a fault to one or more sections of the busbars. They have, however, the disadvantage that, under normal conditions of operation, the current flow across them may cause an undesirable drop in voltage.

The ideal system of bus reactances would afford maximum protection to service and equipment in emergencies, while under normal operating conditions it would give minimum voltage difference between various points in the busbars. The straight bus, the ring bus and the ring and transfer bus approach this ideal condition in the order named.

Reactance coils in each feeder circuit are extremely effective in limiting the flow of current into a short-circuit on the feeder and in isolating the effects of this short-circuit from the other parts of the system.



RELATION BETWEEN EXTERNAL REACTANCE AND SHORT-CIRCUIT CURRENT FLOW

Discussion

Mr. Philip Torchio, New York, called attention to the fact that generators usually have considerably less than 10 per cent inherent reactance (usually about 5 per cent for twenty-five-cycle machines), so that reactors of more than, say, 12 per cent are often required to limit short-circuit currents. He stated further that the effectiveness of reactors is destroyed by placing them between bus sections feeding multiple circuits. The speaker expressed belief that bus-tie reactors should have the same current-carrying rating as the tie switches.

Mr. W. S. Moody, Pittsfield, Mass., emphasized the need of constructing reactors as ruggedly as possible since they may be required to withstand enormous mechanical strains when short-circuits occur. Reactors should be so located and used to the extent that they will not interfere seriously with voltage regulation.

Mr. H. G. Stott, New York, pointed out that generators are now being designed with sufficient internal reactance to protect themselves, so that reactors need be employed only to protect cables and switching apparatus. He described an actual condition where a

three-conductor No. 000 cable was at times subjected to surges of 60,000 amp, producing repulsive forces between the conductors of 1 ton per running foot and showing the need of protective reactors. Besides being subjected to mechanical strains the cables suffered from these surges by high temperature rises. During as short a period as twelve cycles the temperature was noted to rise 1200 deg. C. A so-called "bridge scheme" of connecting reactors was described, in which each generator fed its respective bus and feeders through 5 per cent reactors, 2 per cent reactors being connected between each generator and a transfer bus to maintain synchronous operation of the machines. With this protection it was found that the short-circuit current in the previous case was reduced from 60,000 amp to 20,000 amp. The ideal operating method, Mr. Stott believes, is to insert reactors in the feeder circuits, but too much space is required to make this practicable.

Mr. P. M. Lincoln, Pittsburgh, Pa., declared that transient conditions are often forgotten when designing reactors. The initial short-circuit current is about double the permanent value, as the current oscillations are symmetrical about a logarithmic curve which finally becomes tangent to the base line.

Professor Vladimir Karapetoff, Ithaca, N. Y., suggested using reactance in generator-exciting circuits to minimize short-circuit currents, adding that he had conducted some rough experiments showing it to be effective. Exciter reactances may contain iron cores and need not be large, as the current carried is limited.

Mr. H. R. Woodrow, New York, showed that transient short-circuit currents are less than double the permanent current values as the oscillations when plotted do not originate at the top of the logarithmic curve but at the intersection of the co-ordinate axis. He declared further that reactors are not practicable in the exciting circuit, for by limiting the increase in field current dangerous voltages will occur in the field coils which may puncture the insulation. By employing reactors in the feeder circuits instead of in the generator leads, Mr. Woodrow explained that lower-rated units may be used.

Mr. W. M. Davis stated that where several generators are employed reactors may be connected between bus sections as described in the paper abstracted by Mr. Rossman, but where only a few units are installed it is preferable to use combination generator and feeder reactors similar to those described by Mr. Stott.

In closing this discussion, Mr. Rossman stated that most modern sixty-cycle generators have an internal reactance of about 10 per cent so that the conclusions arrived at in his paper are correct. He disagreed with Mr. Woodrow concerning the economy of using feeder reactors, as a large number would be required, he said, even though their rating may be lower than that for a generator reactor.

Four papers were next read or abstracted on outdoor substations, and were discussed as a group.

Outdoor Versus Indoor Substations

The recent development of the outdoor substation in opposition to the indoor type has resulted, as pointed out by Mr. Alexander Macomber, purely from economic conditions, particularly the desire to serve from transmission systems the small consumer who could not otherwise be reached on account of the high first costs of installation. The classes of apparatus involved which have required development to meet new conditions may in general be grouped under (1) protective equipment, (2) transformers, and (3) control equipment. The production of low-temperature electrolyte for the aluminum-cell lightning arrester now makes it feasible to place the entire equipment out of doors even under the most severe climatic conditions. For outdoor self-cooled transformers special grades of oil are recommended, and in the case of water-cooled transformers precautions must be taken to prevent the freezing of the circulating system. For the above reasons it is suggested that outdoor substations might offer a field for air-blast transformers. For small isolated loads the outdoor equipment required may be of the simplest character, but to supply demands of larger rating the problem becomes more elaborate. An important detail of outdoor installation is that of providing proper facilities for repairs, and large stations should always provide some shelter where repairs can be properly made.

Summing up, the advantages of an outdoor installation are its lower first cost, ease of extension, reduction of fire hazard, and simplicity of layout. With these are to be compared its disadvantages, which include the difficulty of making repairs, operating risks, danger to public, and appearance. For the small isolated substation up to a few hundred kva the cost will be 25 per cent to 50 per cent less than the corresponding indoor station. In large installations the saving will therefore be much smaller. Up to the present time there are installed or under construction approximately 300,000 kva in high-tension outdoor type transformers. Successful operation of installations during several years has shown that operating difficulties are unusual, and the query may well become, instead of "When shall we use the outdoor substation?" rather "When shall it not be used?"

Indoor and Outdoor Substations in Pennsylvania

The paper by Mr. H. L. Fullerton covered in a general way indoor and outdoor substations for pressures up to 20,000 volts, including a discussion of such topics as choice of location, type of building and the arrangement of electrical apparatus. The author divided his subject into two sections: (1) customers' substations fed from the regular distribution system and those fed from the transmission system; (2) company's substations or those installed at a center of load to deliver service to customers in that district. In selecting a location for transformers there should be considered: (1) the position of the customer's load; (2) location of company's street mains; (3) accessibility for delivering material; (4) accessibility for the operating company's employees, and (5) possibilities of ventilation and sewer connections. Among the advantages of outdoor substations which the author enumerated were reduced cost of installation, increased accessibility for employees, lessened difficulty in making connections to lines, absence of transformer vaults, and better ventilation. Indoor installations, on the other hand, offer the advantages of (1) having the apparatus more accessible for inspection or repairs, (2) involving less danger of unauthorized persons interfering with apparatus, (3) giving customers control of the installation on the primary side if desired, and (4) protection of apparatus from the weather.

In making a selection of a site for a company substation there should be considered the location of the present load, future development of the district, distance from existing substations, outlet from the substation for the various feeders, and street frontage. Types of substations were also discussed, particular attention being devoted to one building formed of concrete slabs. Attention was also called to different arrangements of electrical equipment which may be employed for installations of various sizes. Schemes for installing high-tension switchboard apparatus were discussed, emphasis being laid on the open-wire and concrete-cell methods of construction.

Outdoor Substations in New England

The paper by Mr. Fred L. Hunt described the new substations at Chicopee and Agawam, Mass., put into operation by the Amherst Power Company during last summer. Both are operated from the company's double-circuit, sixty-cycle, three-phase, 66,000-volt transmission line from Turners Falls to Springfield. These stations are of the semi-outdoor type in which all of the 66,000-volt equipment, including the stepdown transformers, is placed outdoors, while the 13,200-volt buses and switching equipment, the 2300-volt distributing switchboard and the railway apparatus are mounted inside. The 66,000-volt apparatus, being the most bulky part of the equipment, is placed outside with the idea of making the greatest saving in building space. On the other hand, the complicated switching necessary with the numerous lower-voltage outgoing circuits would have made an outdoor installation for these very difficult and expensive to handle. A building similar to the one actually erected but of dimensions necessary to accommodate indoors all the apparatus, including the 66,000-volt equipment, would have cost on the above basis nearly two and one-half times as much as did the present building. During cold weather the spare transformer provided is connected to the bus on the low-tension side, keeping the temperature of the oil above its freezing point—minus 15 deg. C. When it becomes necessary to disassemble a transformer it is rolled on a transfer truck, which is run into a compartment at one end of the station where there is a hoist to lift and remove the core. The recent winter-weather test of these substations has so far shown very satisfactory results. Some difficulty was first experienced in keeping the joints of the cooling radiators on the transformers oil-tight, owing to the wide range of temperatures to which they were subjected. The design of the radiators has now been changed, and they have thus far stood the test of rapid temperature changes without developing leaks.

Outdoor Substations in the Middle West

Conditions in the Middle West, and particularly in the agricultural districts, often require the construction of small, inexpensive outdoor substations along transmission lines to make the distribution of energy commercially practicable at loads of 300 kw or less. The paper by Mr. Leslie L. Perry described and illustrated a substation which can be built economically to accommodate three 50-kw, 33,000/2300-volt transformers and the distributing equipment. The station described consists of a corrugated-iron or steel transformer compartment 6 ft. square, on top of which are supported electrolytic lightning arresters and a steel angle-iron frame carrying the horn-gaps and choke-coils. Steel framework was recommended as it can be erected at a lower expense than wood and is both durable and non-inflammable. The low-tension equipment, consisting of oil switches, instruments, voltage regulators, etc., should be placed inside the transformer compartment. To allow isolation of the substation equipment from the transmission line when repairs or inspections are being made the author recommended mounting disconnecting switches on a pole near the substation with levers and gear connection which can be operated by any intelligent man. Operation of similar stations has been successful, but improvements in lighting and overload protective apparatus is looked forward to.

Discussion

Prof. D. C. Jackson, Boston, Mass., opened the discussion on the substation papers by calling attention to the opinions held by the authors in common and emphasizing the importance of extending electric service to everyone.

Mr. A. H. Kruesi, Schenectady, N. Y., said that reliability of service should not be sacrificed for economy since the maximum saving occasioned by the use of outdoor substations instead of the indoor type is only about 10 per cent. If outdoor stations are employed they should be limited to small installations which are not absolutely required to furnish uninterrupted service. Mr. Kruesi abstracted a written discussion contributed by his assistant, Mr. Smith, who said that many engineers have been forced into believing that large savings can be effected by constructing outdoor stations. Real economy may result when these stations do not require attendants or where 60,000-volt or higher-voltage equipment is employed. Because of exposure to the weather about 50 per cent more spacing is required between conductors in outdoor installations. Weather conditions also increase the danger of fire from short-circuits, which may destroy the steel framework supporting the apparatus. Messrs. D. B. Rushmore and R. E. Argersinger, of Schenectady, N. Y., also contributed to the discussion.

Mr. H. B. Gear, Chicago, Ill., expressed belief that in choosing the type of installation to use the building cost should be balanced against increased cost of outdoor equipment, but added that the latter may be desirable for other than economic reasons, when no space is available for an inclosure.

Mr. Moody stated that there is probably more than 600,000 kw in equipment installed or being installed in outdoor stations rated at 200 kw or higher. Outdoor stations rated as high as 7500 kw or 50,000 kw have been constructed. Weather conditions make it necessary to design apparatus with water-tight joints, special ventilation and insulation.

Mr. Rossman declared that some small outdoor substations can be built for less than the price of a 33,000-volt oil switch.

Mr. J. C. Smith, Montreal, Que., declared that outdoor stations have not been employed to a large extent in Canada because self-cooled transformers have to be used. The water-cooled type tend to freeze in the severe winter weather unless heated, and this is undesirable.

Mr. P. W. Sothman, New York, proposed adopting the motto "Continuous service if possible within commercial reason," when considering outdoor stations. He prophesied, however, that combination indoor-outdoor stations will probably be employed to a greater extent in cities.

Mr. J. E. Kearns, Schenectady, N. Y., declared that if attempts are made to eliminate unnecessary equipment in indoor stations as is done in the outdoor type the cost of construction will show in favor of the former. He suggested using air-blast transformers for the outdoor type.

Mr. H. E. Bussey, Atlanta, Ga., discredited the economy claimed for outdoor construction and suggested that cost data on these installations be submitted by constructing engineers.

Mr. Farley Osgood, Newark, N. J., declared that outdoor stations are not adapted to use in congested districts or for purposes where much switching is required.

After a remark by Mr. K. C. Randall, Pittsburgh, Pa., to the effect that manufacturers will probably be willing to furnish outdoor equipment for 150,000 volts, Mr. Jackson closed the discussion. He said that where reliability is uppermost in importance indoor stations should be employed, but in sparsely settled districts energy can be delivered economically to those who need it only by employing outdoor substations.

An account of the other sessions on Wednesday night, Thursday and Friday will appear in a subsequent issue.

Public Service Commission News

California Commission

The Mount Whitney Power & Electric Company has filed an application with the Railroad Commission of California, asking for authority to issue $500,000 first mortgage 6 per cent bonds to be sold at not less than 95. The funds are to be used in hydroelectric development work on the Kaweah River.

The Union Hollywood Water Company has filed a complaint with the Railroad Commission of California against the Pacific Electric Railway, complaining against the damage alleged to be sustained by the underground pipes of the water company which run parallel to the right-of-way of the railway.

Indiana Commission

Mr. Thomas M. Honan, Attorney-General of Indiana, in answer to questions from the Public Service Commission, has decided that no Indiana utility, under the new act, may be authorized by the commission to sell bonds at less than 75 per cent of par. Where bonds were authorized prior to Feb. 1, 1913, and not issued, and the company now desires to sell them, the commission may authorize the sale of such bonds at not less than 65 per cent, the Attorney-General held. No utility has the right to ask authorization of bonds to be used as collateral for less than 75 per cent of their face value, according to the decision.

Mr. Charles A. Edwards, a business man of Huntington, has been appointed by Governor Ralston, to succeed Mr. F. E. Payne, of Indianapolis, as a member of the Public Service Commission of Indiana. Mr. Payne resigned on account of ill-health. Lawyers are still in the majority on the Indiana commission, Commissioners Duncan (chairman), Clark and McClure being former judges.

Wisconsin Commission

In a decision issued recently the Wisconsin Supreme Court has sustained the Railroad Commission by upholding the indeterminate permit law. The decision grew out of the case of the Wisconsin Traction, Light, Heat & Power Company against the city of Menasha. The city, which has been furnishing its own street lighting service for some time, has begun recently to do a regular commercial lighting business in competition with the plaintiff and without the necessary authority as conveyed by the certificate of convenience and necessity. The decision of the court, which was contrary to that of the lower court, held that a municipality, as well as a private corporation, must secure a certificate from the Railroad Commission to the effect that public convenience requires the service it proposes to render.

After having refused repeatedly to obey the commission's orders requiring compliance with the standards of service, the Dodgeville Electric Light & Power Company has been ordered to overhaul its entire system promptly and thoroughly so as to render service in full compliance with the standards. The order provides that the company must engage some competent engineer and notify the commission of the fact; that the complete plans and specifications covering the new equipment and changes shall be filed with the commission within thirty days after the engineer is engaged, and that the work shall be completed within six months.

Ohio Commission

The City Council of Cincinnati has adopted a resolution asking the Ohio Public Service Commission to make a physical valuation of the property of the Union Gas & Electric Company to the end that a better idea of a fair and equitable rate for service may be had.

New Jersey Commission

The Board of Public Utility Commissioners of New Jersey has rendered a decision on the application of the Ocean City Electric Light Company for approval of the transfer upon its books of 1193 of the 1200 shares of capital stock of that company to the Atlantic City Electric Company. Originally application was made to the board for permission to transfer the shares to the American Gas & Electric Company, a holding company incorporated in another state. The board refused this application. The application was then amended to provide for transfer of the shares to the Atlantic City Electric Company.

The price proposed to be paid by the Atlantic City company for the Ocean City stock is $305,000. An appraisal of the property of the Ocean City company by the engineering staff of the board indicates that the cost to reproduce new the physical property of the company, including materials and supplies, would be $249,328. This includes no allowance for organization or promotion expenses or the cost of procuring franchises. From this sum there is deducted for accrued depreciation $51,365, leaving as the present value of the structures $197,963. To this there is added as working capital $12,500, making a total of $210,463. There is then added an allowance for all allowable elements of intangible value tentatively reckoned at 25 per cent of the cost of the physical property, or $62,500, making a total of $272,963. This would mean that the purchase price would exceed by $33,000 the value of the property as determined. In this situation the board declines to grant its approval. If it did so it would not be justified later in withholding approval of an application by the Atlantic City company to capitalize the proposed purchase price of $305,000, nor would it be justified later, in proceedings about rates, in refusing to allow $305,000 as the fair value of the property. The companies will be offered an opportunity to question the appraisal and to introduce testimony to establish that the apparent excess of the purchase price over value does not in fact exist.

New York Commissions

Mr. Seymour Van Santvoord, Troy, N. Y., has been nominated by Governor Glynn to be a member of the New York Public Service Commission, Second District, to succeed Mr. Frank W. Stevens, whose term expired a year ago. The nomination was referred to the finance committee of the Senate. Mr. Van Santvoord is a lawyer. He has been prominent as a banker and was one of the organizers of the Trust Companies Association of New York State.

Pennsylvania Commission

The Public Service Commission of Pennsylvania has passed an order regulating the crossing of facilities of one public service company with those of another public service company. Before constructing any structures or other facilities across the structures or other facilities of any other public service company, whether underground or above ground or at the same or different levels, in the absence of an agreement between the companies affected, a company shall serve ten days' written notice upon the company whose structures it is so desired to cross. This notice shall specify the nature and character of the contemplated crossing and the exact location thereof. A copy, with proof of service, shall be filed with the commission. The commission may fix a time and place for a hearing to determine whether or not the crossing shall be approved. The regulation shall apply to all crossings between the structures or facilities of public service companies other than crossings between railroads and street railways.

Current News Notes

Mr. Taft's Address on Signs of the Times.—The Electrical Manufacturers' Club has published in pamphlet form the address on "The Signs of the Times" given by Ex-president W. H. Taft before the club at its meeting at Hot Springs, Va., on Nov. 6, 1913. A report of this meeting was published in the *Electrical World* on Nov. 15, 1913.

* * *

Engineering Societies Exhibit at Ohio Northern University.—The annual exhibition of the engineering societies of Ohio Northern University, Ada, Ohio, was held on Feb. 20. All the engineering departments were represented. Among the electrical exhibits were various direct-current and alternating-current machines, high-voltage insulators, lighting fixtures, heating appliances, etc. Experiments with high-frequency currents of about 100,000 volts were given.

* * *

Telephone Growth in Chicago.—A committee of the Chicago Telephone Company which has made an exhaustive study of population probabilities predicts that the population of Chicago and its immediate environs in 1930 will be 4,000,000. At that time it is predicted that the number of telephones in Chicago will be about 1,000,000. The present number is about 375,000. The Chicago Telephone Company now employs about 13,200 persons, of whom 5700 are men and boys and 7500 are women and girls.

* * *

Electricity to the Gas Stove's Aid.—During the recent cold snap a householder in an Eastern city found his kitchen gas supply frozen and chances for breakfast poor as the gas stove was depended upon for cooking. Recollecting, however, his trusty electric iron, the hungry householder attached an extra lamp cord and proceeded to "iron" vigorously the gas pipe in the cellar. After a few minutes of this treatment, the gas came gurgling cheerily through the pipe and it was not long before coffee and eggs were steaming on the table.

* * *

SOCIETY MEETINGS

Michigan University Branch, A. I. E. E.—Mr. H. H. Conant spoke on the topic "Commercial Applications of Storage Batteries" before the University of Michigan Branch of the American Institute of Electrical Engineers at its meeting Feb. 12.

* * *

Banquet of Grand Rapids Jovians.—Members of the Jovian Order living in Grand Rapids, Mich., and vicinity held a banquet and initiation at the Hotel Pantlind in that city Feb. 13. Mr. H. A. Robseverry, local statesman, was in charge of the ceremonies, during which twelve novices were admitted into the order.

* * *

Fire Prevention by Means of Code Building.—At the bi-weekly luncheon of the New York Section of the Jovian Order, Feb. 25, Mr. Abram W. Herbst, director of safety American Society for Fire Prevention, and chairman of the committee of buildings of the 1912-13 Board of Aldermen, New York, spoke of the need of proper legislation to eliminate the conflicting authority of the different city departments in regard to the installation of various kinds of electrical apparatus. The speaker stated that the electrical code as now existing in New York City has never been approved by the Board of Aldermen, but that a new code is being drafted, which, it is hoped, will soon obtain the sanction of this body.

Motor Truck Club of America.—At a meeting of the Motor Truck Club of America held Feb. 18 at the Automobile Club of America, New York City, Dr. L. L. Hewes, chief of the Bureau of Economics, Washington, D. C., presented a paper by Mr. Logan Waller Page, director of the Bureau of Public Roads, reviewing the work done by the government in gathering data on highway traffic and wear, establishing standards of construction, etc.

* * *

Boston Electric Vehicle Campaign Dinner.—The third anniversary of the inauguration of the electric-vehicle campaign by the Edison Electric Illuminating Company of Boston is to be observed by a dinner at the American House in that city on Tuesday evening, March 3, at 6:30 o'clock. Men prominent in the automobile business, including manufacturers and agents, as well as publishers and representatives of automobile publications and also members of the Electric Motor Car Club, have been invited to attend.

* * *

Electric-Vehicle Men to Enjoy a Social Evening.—Something of a departure in the program of the Chicago Section of the Electric Vehicle Association is a "social evening," which is planned for the night of March 3. A dinner for members and guests will be given at the Schiller Café and Bowling Alleys, 318 East Thirty-first Street. After the dinner there will be a bowling contest on the ten alleys available. Billiard and pool tables will also be available for those who prefer this form of recreation. Tickets can be obtained from the committee in charge of the affair, consisting of Messrs. E. J. Kilborn, General Motors Truck Company; C. B. Frayer, Edison Storage Battery Company, and F. A. Putt, General Electric Company.

* * *

"Tech" Alumni Reunion in Chicago.—A reunion of the alumni of the Massachusetts Institute of Technology was held in Chicago on Feb. 20 and 21. It was given under the auspices of the Technology Clubs Associated and the Northwestern Association of Alumni. Headquarters were maintained at the Blackstone Hotel, where a banquet was given. An informal dinner and smoker was held at the University Club. There were excursions to the generating stations of the Commonwealth Edison Company, Underwriters' Laboratories, Hawthorne works of Western Electric Company and other points. President Maclaurin spoke on the "New Technology" at the smoker of Feb. 20. President Lowell of Harvard University was one of the speakers.

* * *

Engineers' Dinner in Boston.—The fifth annual dinner to be given jointly by the Boston Section of the American Institute of Electrical Engineers, the Boston Society of Civil Engineers and the Boston Section of the American Society of Mechanical Engineers will be held at the City Club of that city on March 4, at 6 p. m. This dinner is primarily intended to promote the social and professional interests of all engineers of Boston and vicinity and affords an opportunity to consider their broader civic relationship. The guests of honor of the evening will be Mr. Guy E. Tripp, of the Westinghouse Electric & Manufacturing Company, New York, who will speak on "The National Government and Business"; Dr. A. E. Kennelly, professor of electrical engineering, Harvard University, whose subject will be "Results for the Electrical Engineering Fraternity Accomplished by the I. E. C.," and Dr. M. W. Franklin, of the Sprague Electric Works of Bloomfield, N. J., who will speak on "Ozone Applied to Ventilation." Mr. N. J. Neale is chairman of the committee of arrangements for the dinner.

Turbo-Alternator Plant for Louisville Railways

Modern steam station of the Louisville Traction Company planned for an ultimate rating of 48,000 kw—Provisions for coal storage—Intakes for supplying circulating water from the Ohio River

ON the south bank of the Ohio River at a point above the Louisville dam and rapids the Louisville Traction Company, owner of the Louisville Railway and the Louisville & Interurban Railroad Company, has just placed in service its modern turbo-generator plant which supplies energy to operate the street-car and interurban lines of Louisville and vicinity. The Louisville Railway system embraces about 165 miles of city tracks, and the Louisville Interurban Railroad Company operates 96 miles of traction lines radiating from Louisville as a center, out through Jefferson, Oldham and Shelby Counties.

The new plant transmits 13,200-volt, twenty-five-cycle, three-phase energy to two city substations and to the company's old generating station on Campbell Street, Louisville, from which point in turn are fed six substations on the seven interurban lines radiating from the city. The recently completed waterside plant of the traction company begins operation with an equipment of 12,000 kw, although it has been designed for an ultimate rating of 48,000 kw when the present plans are completely carried out.

Prior to the construction of the new station the Louisville city and interurban traction system was supplied with electrical energy from the above-mentioned Campbell Street plant, which is situated on Beargrass Creek. This station contained one 3500-kw and one 3000-kw steam turbine and two 1650-kw reciprocating vertical engine-type units, all generating 13,200-volt, twenty-five-cycle, three-phase alternating current. In addition the old plant was equipped with several 550-volt direct-current generators, making a total of 14,600 kw, besides a 3000-amp-hr. storage battery which was used as a reserve during peak-load periods.

Beargrass Creek, on which the old plant was situated and from which circulating water was obtained, formerly received the discharge from a number of sewers. This did not materially impair the value of the water for use in the condensers, but within the past five years the city of Louisville constructed several sewers parallel to the creek, resulting in a reduction of the flow of water in the creek itself to an almost negligible quantity. The situation thus arising made it necessary for the railway company to seek either a new supply of condensing water or a new site for a power station. To put off the day when it would be necessary to build a new plant the company first sank artesian wells and installed a spray cooling system to furnish condensing

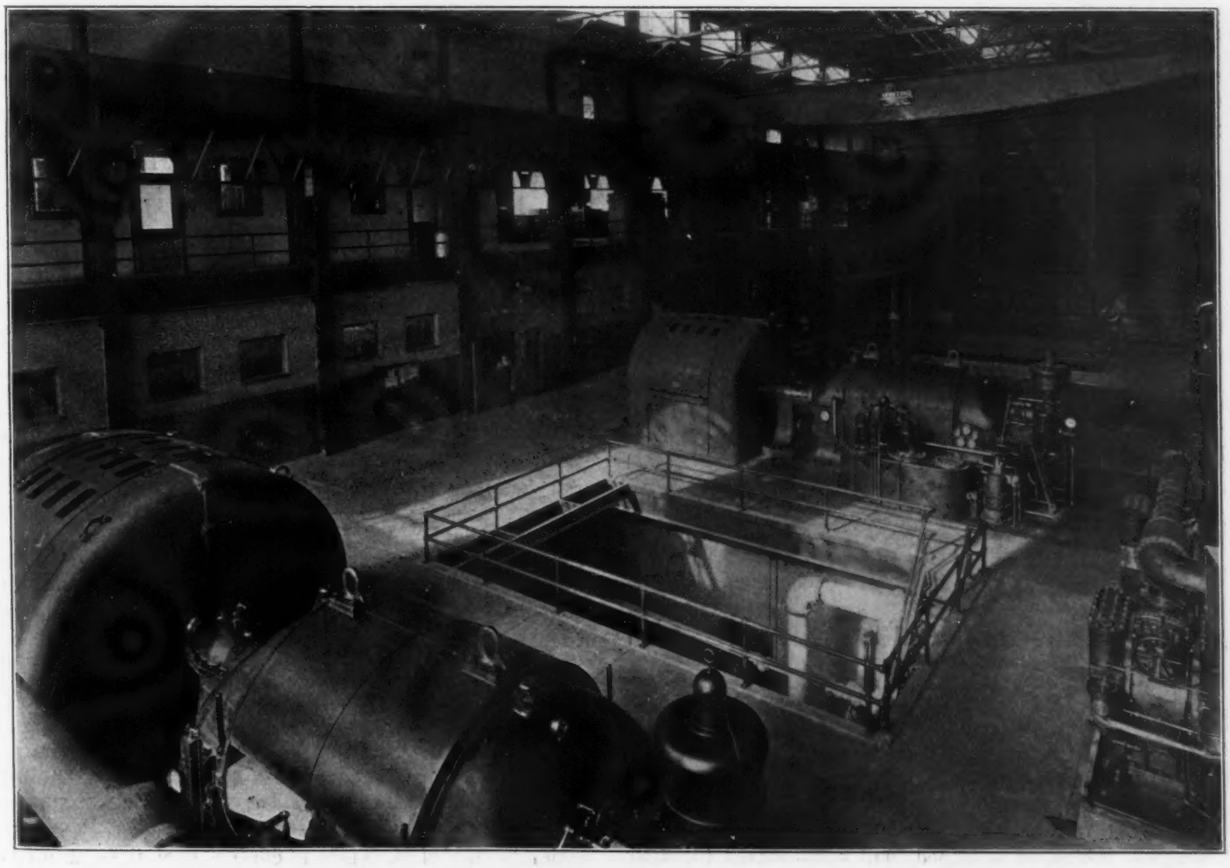


FIG. 1—TURBINE ROOM, LOOKING WEST, LOUISVILLE TRACTION COMPANY STATION

water. Such methods, with the limited quantity of water available and the amount of pumping necessary, proved, however, costly and materially reduced the efficiency of the plant. To eliminate these difficulties and at the same time to take advantage of modern generating efficiencies, it was decided to build a new station at a more advantageous location where plenty of water would be available.

periods, coal strikes and transportation accidents. To obtain these necessary requirements a site for the new plant was selected on the Ohio River. At a point in the river opposite Louisville the federal government has built a removable dam to limit the low-water stage in the Louisville harbor. Rapids in the river opposite the city have also made necessary locks for transporting boats around the falls during low river stages. Accordingly property for the plant was purchased above the locks at a point where a definite minimum stage of the river could be obtained.

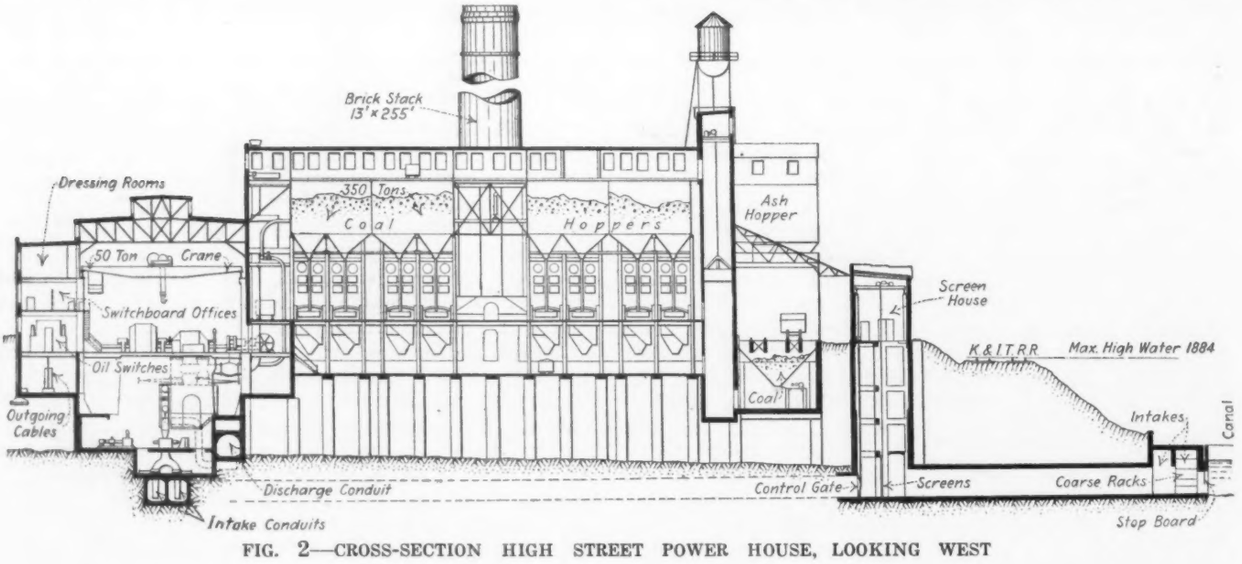


FIG. 2—CROSS-SECTION HIGH STREET POWER HOUSE, LOOKING WEST

In the meantime the average daily output of the existing plant had increased from 35,000 kw-hr. in 1900 to practically 150,000 kw-hr. by the close of 1912. At the same time the maximum demand rose from 3000 kw in 1900 to 15,000 kw in 1912. This rapid growth in the output was due to several causes, including the increased car mileage, track mileage, car sizes and car equipment. During 1902 the generating station output was 1.5 kw-hr. per car mile; in 1905 this had increased to 2.5 kw-hr. and in 1912 to approximately 3.9 kw-hr. per car-mile.

Factors entering into the selection of the new generating site may therefore be summarized as (1) ample condensing water supply, (2) ready access to steam-road transportation, and (3) cheap real estate so as to permit open storage of coal to tide over high-water

Features of Station Layout

The new plant site fronts 1358 ft. on the Kentucky & Indiana Terminal Railroad Company's right-of-way, which adjoins the Louisville & Portland canal. The transportation facilities offered at this location are especially desirable, because this railroad forms a part of a double-track belt line around about half the city and connects with all the steam roads entering Louisville. In addition, the general level of the plant property is approximately 5 ft. above the maximum high-water stage of the river. The site is underlaid with bed-rock at a depth of about 36 ft.

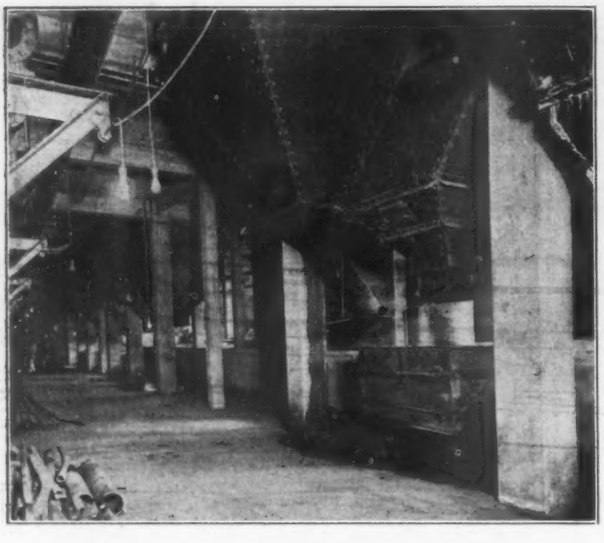


FIG. 3—STEEL ASH BINS FOR LOADING CARS

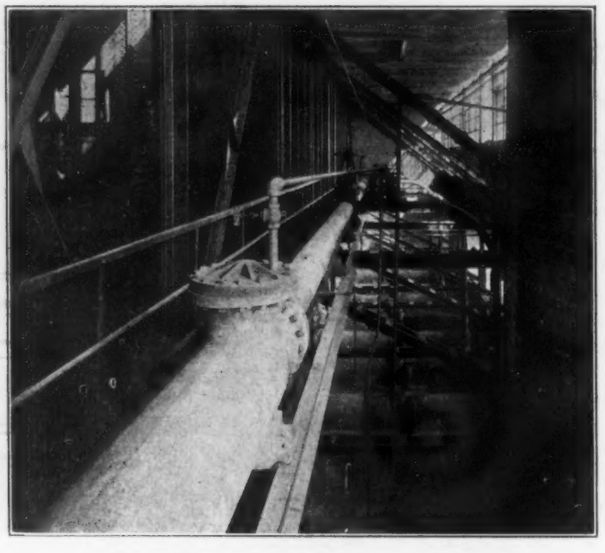


FIG. 4—STEAM MAIN OVER BOILERS

Switches at each end of the plant property connect to a long side track paralleling the steam road's right-of-way. A lead from one end of this side track in turn branches into five tracks, two of which lead over the coal hopper beside the boiler house, one into the boiler house and one into the generating room under the crane. The space remaining between these four tracks furnishes sufficient area to store two or three months' coal supply in the open. This space has been graded so that all surface water drains off readily. Approximately thirty cars of coal will be required every twenty-four hours for the completed station, and the yard layout of 4000 ft. of track provides for two days' supply of coal on cars at all times, with extra space for one day's empties.

Fuel purchased for storage purposes will be either "mine run" or a combination of nut and slack coal, and will be piled in the yard to a height of approximately 15 ft. By providing a well-drained storage area and limiting the height of the piles it is believed that spontaneous fires will be reduced to a minimum.

The first section of the generating station includes a boiler room, 100 ft. by 180 ft. in plan, built with its long axis at right angles to the turbine room, which is 80 ft. by 175 ft. This boiler room houses the initial equipment of eight 507-hp boilers with spare space for a duplicate battery under the same roof. The turbine room was also designed large enough not only to house the initial installation of two 6000-kw steam turbines but to provide space also for the foundations of two additional units. The buildings are constructed of plain and reinforced concrete, brick and steel, and are thoroughly fireproof structures. They rest either on concrete caissons taken down to rock or on concrete mats resting on Ransome concrete piling driven to bed-rock or to refusal. Ample provision is made for natural illumination and ventilation in the turbine and boiler rooms by large window-glass areas with Fenestra steel sash. In addition, a double monitor skylight surmounts the firing aisle of the boiler room and the long axis of the turbine room.

Boiler-Room Equipment

For serving the initial installation of eight 507-hp Babcock & Wilcox boilers a 13-ft. by 255-ft. dark-red radial-brick stack was erected by the H. R. Heinicke Company on a concrete foundation resting on bed-rock. This stack provides 1 sq. ft. of area for each 36.25 hp. The present boiler equipment generates steam at 200 lb. pressure per sq. in. and 125 deg. Fahr. superheat. Each unit is equipped with a Babcock & Wilcox chain-grate stoker having a grate 9 ft. 6 in. wide by 12 ft. 3 in. long. This size of grate was particularly designed to produce economical results with the Kentucky pea and slack coal used.

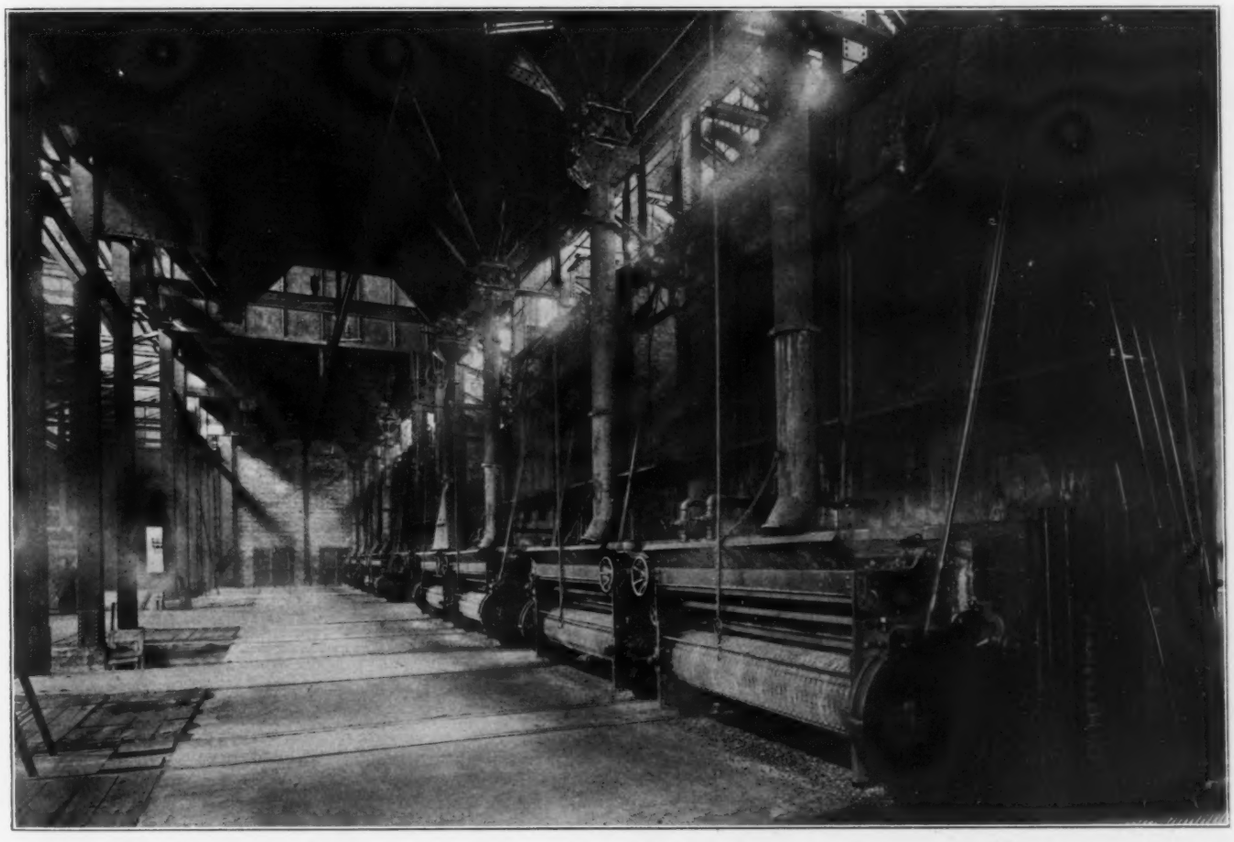


FIG. 5—BOILER ROOM, SHOWING EIGHT UNITS, COAL BUNKERS AND STEEL IN PLACE FOR SECOND ROW OF BOILERS

The stack rises to an elevation 253 ft. above the grate level, and with six of the boilers in service the draft at the base of the stack has averaged 1.2 in. of water. Tests made over the front of the grates, the main breechings and the boiler dampers being open, showed pressure of 0.45 in. of water, while the draft at the last boiler pass measured 1 in. of water. A preliminary test of station efficiency during the second month's operation, before the steam piping was completely covered, and while some steam was being used for drying out and testing purposes, gave a coal consumption of 2.975 lb. per kw-hr. with 12.5 per cent ash. The coal used was Western Kentucky pea and slack, containing approximately 12,000 lb.-Fahr. heat units per lb. when dry.

From these receiving track hoppers, 2-ton hand push

cars convey the coal to the structural-steel bunkers over the boiler room by way of duplicate electric elevators. An industrial railway leads from the elevator shaft over the battery of bunkers so that these cars may be pushed by hand and dumped at any point desired. The two platform elevators measure 10 ft. by 10 ft. in size and are of 6000-lb. capacity. They were designed

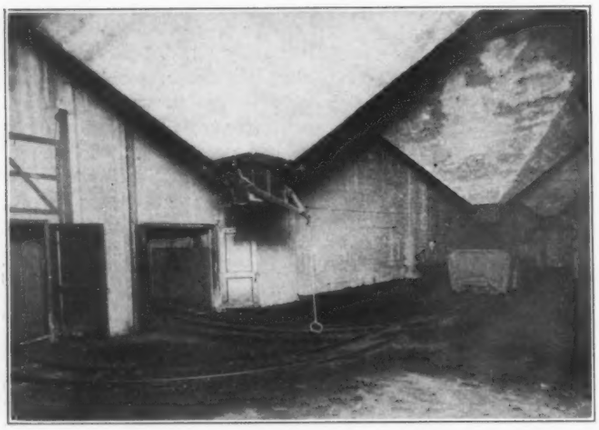


FIG. 6—CONCRETE COAL HOPPERS UNDER COAL-UNLOADING TRACKS

to operate at 100 ft. per minute, one being driven by a 550-volt, 30-hp direct-current motor and the other by a 440-volt, 30-hp, three-phase alternating-current motor.

Each battery of two boilers is equipped with a coal bin holding 225 tons, which represents four and one-half days' fuel supply for ordinary operation. This large coal-bin capacity was deemed necessary as a precaution against shortage during extreme high-water periods when the tracks of the steam railroad might be inundated.

The ashes drop from the chain grates into two steel ash hoppers lined with firebrick and are dumped into push cars on an industrial railway. Siftings from the grates are dumped into the cars and returned to the coal bunkers. The small cars loaded with ashes are elevated to a steel ash hopper lined with firebrick, which is installed over the coal-unloading hoppers. By this

FIG. 7—SWITCHBOARD GALLERY

arrangement after the coal has been unloaded into the track hoppers the cars may again be loaded with ashes from the hoppers overhead.

Piping Layout of the Station

Under normal conditions boiler-feed water will be taken from two 5000-hp Cochrane feed-water heaters placed on the boiler-room floor. This firing floor is 12 ft. above the turbine floor, and the latter projects 15 ft. underneath the boiler room. In this 15-ft. space are installed the station auxiliaries, such as the dry vacuum pumps, the air compressor and the boiler-feed pumps. This allows the boiler-feed pumps to be placed directly beneath the feed-water heater and gives a head for the boiler-feed pumps of 12 ft. plus 3 ft., the height of the heater above the floor. The two boiler-feed pumps are Jeansville 4-in., four-stage, centrifugal sets driven by General Electric steam turbines.

A 35,000-gal. general-utility steel water-supply tank, manufactured by the Henry Vogt Machine Company, Louisville, is installed on top of the elevator shafts over one end of the boiler room. The tank overflow level is 119 ft. above the turbine-room floor, and the tank is supplied with water from one of two steam reciprocating house pumps which take their water from one of the two main 7-ft. by 8-ft. water intakes. A float valve in the tank closes the inlet when the water rises to within 6 in. of the overflow level, thereby producing pressure on the service pump discharge which automatically stops the pump.

An elevation gage installed over the engineer's desk in the turbine room is graduated in feet to indicate the height of the water in the tank. The tank provides

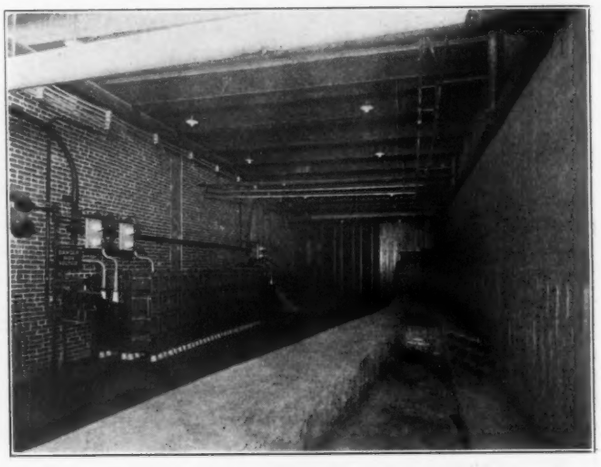


FIG. 8—CABLE ROOM, SHOWING ALTERNATING-CURRENT AND DIRECT-CURRENT CABLE SYSTEMS

uniform head, against which the service pumps operate. Water from the tank is also used for the make-up supply to the feed-water heaters, for water-cooled glands in the main turbines, centrifugal pumps and exciters, and for wetting down ashes and coal, as well as for general washing purposes about the plant.

The steam-pipe layout includes one steam header installed over the front of the boilers and at right angles to the turbine room. This header varies in size from 12 in. to 16 in. and is connected to a cross-header in the boiler room running parallel to the turbine room. Out of this cross-header steam is taken to the turbines by way of 12-in. long-radius bends. Two 10-in. long radius bends take the steam to an auxiliary header in the basement of the turbine room, which in turn feeds all station auxiliaries. When the second row of boilers is installed a ring system of steam piping is contemplated which will encircle the boiler room so that any battery or any steam bend may be cut out of service for repairs without disturbing the other steam units.

All headers and valves are of cast steel. The headers were furnished by the Crane company. The valves, which were supplied by the Chapman company, have solid monel-metal seats and stems. All bends are of extra-heavy steel with Crane-lap joints and steel

flanges. The connection to each boiler is equipped with a Lunkenheimer automatic cut-off valve.

Circulating water for the plant is taken from the canal through eight 4-ft. 8-in. by 8-ft. openings, the bottoms of which are approximately 50 ft. below the generator-room floor, or 12 ft. below normal water level in the canal. The top of these intake openings is approximately 4 ft. below normal water level, which, it is hoped, will eliminate a certain amount of floating trash from clogging the intake screens. Just inside the intake openings in the canal walls there are four cast-iron racks set at 20 deg. to the vertical and composed of 4-in. by 1½-in. bars with 2-in. openings between them for screening off logs and large trash. Manholes are provided over each of these racks in the intake structure so that any trash collected may be hauled out with a long-handled fork.

A duplicate set of screens is installed in a screen house on the railway company's property, approximately 90 ft. from the intake. At the screen house, which measures 18 ft. 6 in. by 30 ft. 4 in. in plan, the intakes flare to provide supports for stop planks and a double row of movable vertical screens. The latter have been installed with four double screens in each of the four channels. In each channel the screen nearest the intake is of ⅞-in.-mesh No. 8 copper wire and the second screen is ½-in.-mesh No. 10 copper wire. Each screen is set in a substantial angle-iron frame 7 ft. ¼ in. wide by 14 ft. 9 in. high, and these frames have slight angle projections which slide in cast-iron vertical slots set in the concrete. A Whiting electric crane installed on runways facilitates raising and lowering the screens and stop boards.

The size of the openings for both intake and discharge were figured for a flow of 160,000 gal. per minute, or 20,000 gal. per minute for each of the eight units in the initial station installation. At this rate of flow the openings produce a discharge speed of only 1.19 ft. per second, such a reduction having been necessary in order not to interfere with small boats passing in the canal.

Two 30-in. cast-iron pipes are laid over the outside walls of each intake conduit. These pipes are continuous from taps in the discharge-water conduit to the inlet at the canal end of the intake and were provided to protect the intakes from clogging with needle ice. Valves installed in these cast-iron connections may be opened and hot water discharged into the canal at the mouth of the intakes. As the hot water is taken from the discharge conduit the only expense involved is that of maintaining the pipe line from the turbine room to the intake structure at the canal.

Turbine-Room Arrangement and Equipment

The turbine room and its basement for the auxiliaries measure 174 ft. long by 61 ft. 6.5 in. wide, with four galleries on one side, 21 ft. 10.5 in. in width. The turbine room is served by a 50-ton Whiting crane. Each turbine foundation consists of two parallel walls resting on bed-rock and extending to within 18 in. of the main turbine-floor level. These walls are so placed and spaced that the surface condensers may be dropped in place under each turbine by the overhead crane. The turbine proper rests on an I-beam grillage, supported in turn on the two concrete foundation walls. Special attention was given to the design and installation of these turbine concrete foundations in view of the fact that their bases are below water level in the river.

The circulating pumps are installed 45 ft. below maximum high water and only 1 ft. above the low-water stage of the Ohio River. This has made it necessary to seal all pipes into the concrete conduit to prevent flooding during high water, when all the waterways inside the building are under very great pressure.

Each of the 6000-kw horizontal Westinghouse turbo-generators is equipped with a 20,000-sq. ft. Worthington surface condenser. The dry vacuum pumps were manufactured by the Laidlaw-Dunn-Gordon Company. Circulating water is supplied to each condenser by a Worthington 26-in. tri-rotor centrifugal pump, driven by a General Electric steam turbine. Each has an emergency 30-in. pipe connection to the circulating pump of the other turbine. The units are arranged in pairs with condensing auxiliaries in a pit between the two foundations. Thus the first two units will be spaced 45 ft. apart and the second and third units will be 30 ft. apart. In this way one operator can care for the auxiliaries of two units. This arrangement also

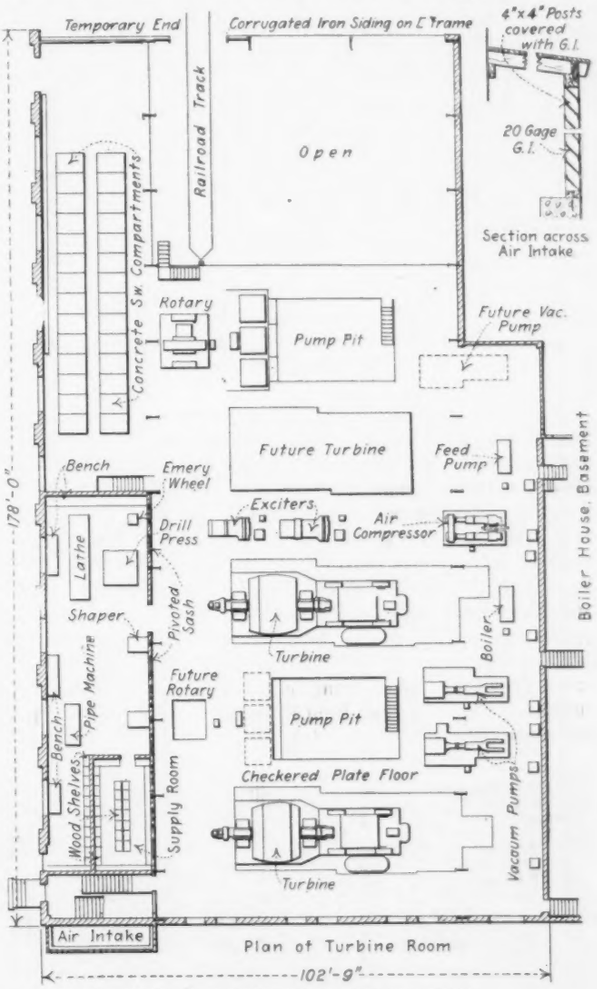


FIG. 9—PLAN OF TURBINE ROOM

permits sets to be cross-connected more readily and economically. The dry vacuum pumps, the main circulating pumps and the hot-well pumps are connected and arranged so that either generating unit may be used with either of the auxiliaries. A 4-in., two-stage Worthington hot-well pump driven by a 27-hp Terry steam turbine completes the steam-turbine equipment.

The turbo-generators deliver 13,000-volt, twenty-five-cycle, three-phase energy, which is transmitted out over the feeder lines at this same bus pressure. Tirrill regulators control the voltage of the main alternators, the excitation energy for which is supplied by a 30-kw motor-driven direct-current set and by one 100-kw and one 150-kw steam-turbine-driven exciter set.

The first 2000-kw rotary converter has been installed on one of the foundations provided for it beside the

auxiliary pit and feeds the trolley sections in the vicinity of the new generating station. This substation equipment is tied in with the two city substations by way of a 600-volt direct-current trunk line. This installation required three 750-kw single-phase oil-cooled, step-down transformers rated at 13,200/440 volts.

Oil for turbine lubrication passes through oil filters

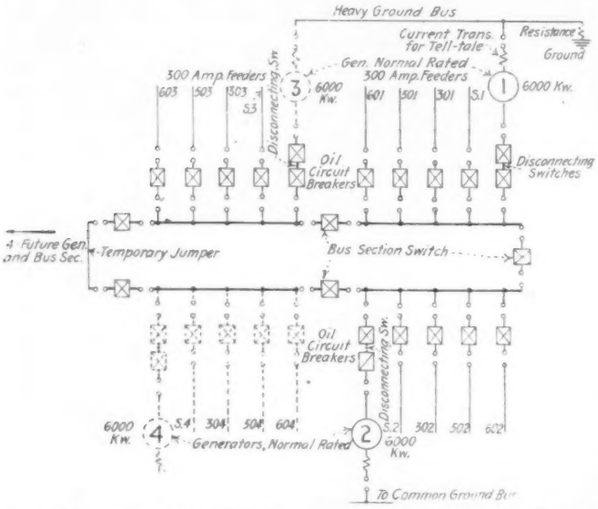


FIG. 10—BUS AND FEEDER ARRANGEMENT HIGH STREET POWER STATION

installed in the basement. From these duplicate Marsh pumps pump the filtered oil to a tank over the coal bunkers in the boiler room. From this elevation oil may be supplied to all parts of the turbine without pumping even should a breakdown occur in the oil-pressure system supplied by the pumps. Oil for the auxiliaries, such as the dry-vacuum pumps, boiler-feed pumps, etc., is provided by individual tank systems.

A four-level gallery adjoins one side of the turbine room. On the lowest gallery, which is below the turbine-room floor, the conduit carrying the underground transmission cables is brought in from the street. From the conduit the cables radiate through the necessary cable-end bells, supported from a central

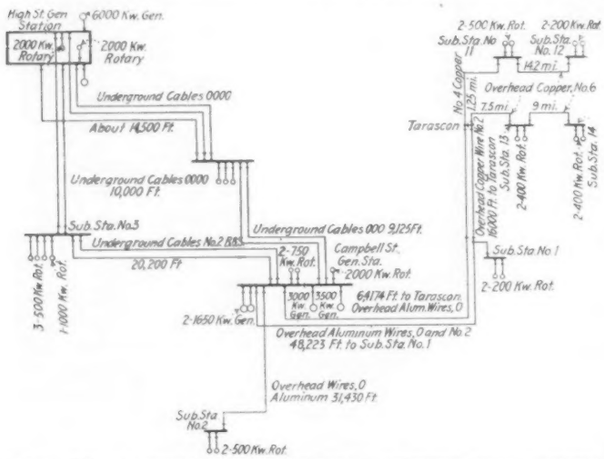


FIG. 11—ALTERNATING-CURRENT DISTRIBUTION SYSTEM

concrete wall which also carries the transformer compartments. This compartment extends the full length of the turbine room and is completely separated from the basement under the turbine-room floor by a 13-in. brick curtain wall. All openings between this gallery and the turbine room are fitted with doors so that the space may be entirely closed and used as an air chamber to supply air to the turbines. An air intake is provided outside of the station at one end of this lower gallery, and air is taken into this chamber by way of louvered openings. After the air passes through the intake into this lower gallery it is screened through ¼-in. mesh copper screens covered with cheesecloth and set at 30 deg. to the direction of the air current.

A machine shop is situated on the main-floor gallery along with the tool and storerooms and with the oil switches controlling the high-tension generator and feeder circuits. These 13,200-volt switches are installed in the concrete switch and bus structure, which is built in two parallel sections. At the present time these two sections are divided at their mid-point, so that there are four sections of the high-tension bus. The bus and feeder arrangement is such that each section of the bus connects one generator and four feeder switches. Each generator has two oil switches in series while each feeder is provided with a single oil switch. Disconnecting switches are provided in each phase and on both sides of each oil switch so any one may be cut out of service for repairs or cleaning.

The complete high-tension bus structure was built for four generating units and sixteen feeders. The structure itself has been erected for the complete station, but the total number of feeder oil switches is not

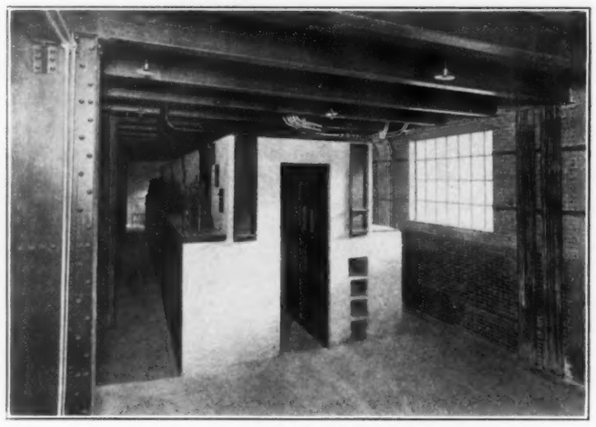


FIG. 12—CONCRETE BUS STRUCTURE

to be installed at this time. All generator switches are non-automatic and the feeder oil switches and junction bus section switches are automatic and provided with inverse time-limit relays.

Offices, drafting rooms and laboratory, switchboards and the main desk control board are installed on the first gallery above the turbine-room floor. The panels for the control desk and exciters, as well as outgoing alternating-current and direct-current feeders and the turbine-desk control board, have been placed at one end of this gallery; that is to say, they will be at the center of the turbine-room building when it has been enlarged to conform to proposed future extensions. A balcony extends into the turbine room beyond the gallery line, just in front of the control board, so that the operator, by stepping out onto it, may have a clear view of the turbine-room floor below.

The electrical and mechanical features of this new generating station were designed by the motive-power department of the Louisville Railway Company under the direction of Mr. F. H. Miller, superintendent of motive power. D. X. Murphy & Brother, of Louisville, were the architects, and the Henry Bickel Company, of Louisville, contracted for all excavation, underground waterways and concrete foundations. The electrical and mechanical equipment was purchased installed.

Resonance in Radiotelegraphy—II

General consequences of resonance phenomena and their effects on circuits in which high-frequency currents occur. By J. Hettinger

IN the Feb. 21 issue of the *Electrical World* there was given an account of the present-day theory and the writer's theory of the resistance phenomena in high-frequency circuits. The concluding outline of the latter is given below.

General Consequences

The Increase of Amplitude.

The diagram illustrated in Fig. 7 shows clearly the following characteristics of the resonance phenomenon:

(a) The half B of the forced oscillation reinforces the half A_1 of the first free oscillation; the half C of the forced oscillation reinforces the half B_1 of the second free oscillation and the half A_2 of the first free oscillation; the half D of the forced oscillation reinforces the half C_1 of the third free oscillation, the half B_2 of the second free oscillation and the half A_3 of the first free oscillation, etc., the tenth half oscillation J of the forced oscillation reinforcing the half oscillations I_1, H_2, G_3, F_4, E_5, D_6, C_7, B_8 and A_9 of the ninth, eighth, seventh, sixth, fifth, fourth, third, second and first free oscillations respectively. The eleventh half oscillation K and all the subsequent half oscillations of the forced oscillation reinforce in the case illustrated—of an undamped forced oscillation—the same number of free oscillations as the tenth half oscillation J. This result is attributable to the gradual disappearance of the various damped free oscillations and the gradual appearance of fresh free oscillations. The number of superposed free oscillations in the example illustrated is nine. This number agrees with the number of half oscillations which each free oscillation performs until it completely dies away, a fact which can easily be followed from the diagram without further explanation. Moreover, the various amplitudes of the nine free oscillations reinforced by the half oscillation J are equal to the various amplitudes of the nine free oscillations reinforced by the half oscillations K, L, etc., respectively, so that the corresponding resultant amplitudes are equal to one another. The following conclusions are therefore derived:

(1) In the case of resonance the amplitudes of the resultant oscillation continuously increase until the first free oscillation has completely died away.

(2) In the case of an undamped forced oscillation the amplitudes of the resultant oscillation remain constant after the first free oscillation has ceased to oscillate.

(3) The amplitudes of the resultant oscillation are at all times greater than the amplitude of the forced oscillation.

(b) The maximum amplitude attained in the case of resonance can be found as follows: In the case illustrated the amplitudes of all the half oscillations of the forced oscillation are equal to one another, and therefore the free oscillations must be identical with one another, with regard to both the various amplitudes and the number of half oscillations performed by each free oscillation. We thus get:

$$A = B = C = D = E = F = G = H = I = J = K = L$$
$$A_1 = B_1 = C_1 = D_1 = E_1 = F_1 = G_1 = H_1 = I_1 = J_1 = K_1 = L_1$$
$$A_2 = B_2 = C_2 = D_2 = E_2 = F_2 = G_2 = H_2 = I_2 = J_2 = K_2 = L_2$$
$$A_3 = B_3 = C_3 = D_3 = E_3 = F_3 = G_3 = H_3 = I_3 = J_3 = K_3 = L_3$$
$$A_4 = B_4 = C_4 = D_4 = E_4 = F_4 = G_4 = H_4 = I_4 = J_4 = K_4 = L_4$$
$$A_5 = B_5 = C_5 = D_5 = E_5 = F_5 = G_5 = H_5 = I_5 = J_5 = K_5 = L_5$$
$$A_6 = B_6 = C_6 = D_6 = E_6 = F_6 = G_6 = H_6 = I_6 = J_6 = K_6 = L_6$$
$$A_7 = B_7 = C_7 = D_7 = E_7 = F_7 = G_7 = H_7 = I_7 = J_7 = K_7 = L_7$$
$$A_8 = B_8 = C_8 = D_8 = E_8 = F_8 = G_8 = H_8 = I_8 = J_8 = K_8 = L_8$$
$$A_9 = B_9 = C_9 = D_9 = E_9 = F_9 = G_9 = H_9 = I_9 = J_9 = K_9 = L_9$$

and consequently:

$$J + I_1 + H_2 + G_3 + F_4 + E_5 + D_6 + C_7 + B_8 + A_9 =$$
$$K + J_1 + I_2 + H_3 + G_4 + F_5 + E_6 + D_7 + C_8 + B_9 =$$
$$A + A_1 + A_2 + A_3 + A_4 + A_5 + A_6 + A_7 + A_8 + A_9 \qquad (1)$$

That is to say:

The maximum amplitude of the resultant oscillation in the case of resonance and when the forced oscillation

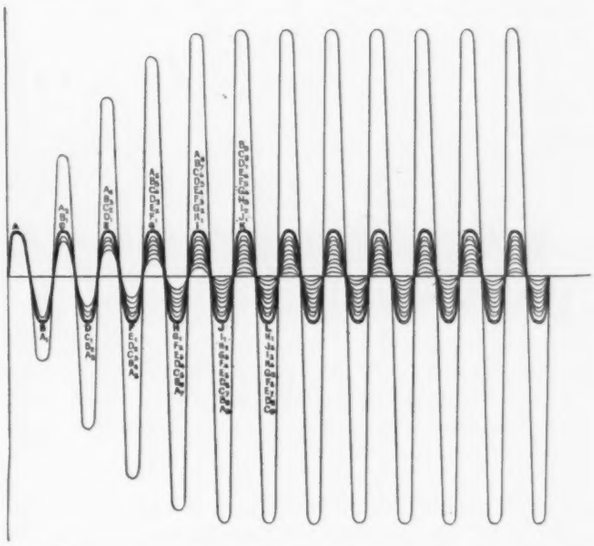


FIG. 7—SUPERPOSITION OF THE FORCED OSCILLATION AND SERIES OF FREE OSCILLATIONS

is undamped can be obtained by adding together the amplitude of the forced oscillation and the amplitudes of all the half oscillations of a complete free oscillation, irrespective of their signs.

(c) For the sake of convenience the damped free oscillations in Fig. 7 and in other subsequent illustrations are shown as decreasing according to a straight line. This, of course, is not correct, it being well known that the amplitudes of damped oscillations decrease according to an exponential curve, but, as can easily be appreciated, the results hereinbefore described are in no way affected by the simplified assumption made. However, the problem of the maximum amplitude will now be considered with a view to obtaining a formula for determining its exact value and for this purpose the true conditions must be taken into account.

The apexes of the amplitudes of a damped oscillation lie on an exponential curve of the form

$$A_x = Ae^{-\delta t} \qquad (2)$$

wherein A is the amplitude at the moment $t = 0$; A_x the amplitude at any moment t; e the basis of the

natural logarithm, and δ the damping factor of the oscillation.

If time be counted from the moment when the half oscillation A attains its maximum amplitude, and the half period be made $= T$, the following amplitudes are obtained for the half oscillations A_1, A_2, A_3 . . . . A_9, in addition to the amplitude A for the forced half oscillation:

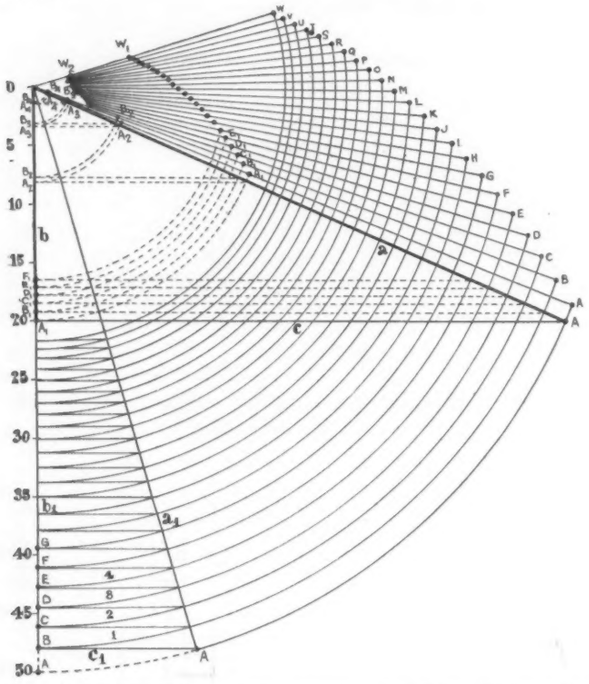


FIG. 8—GRAPHICAL CONSTRUCTION OF THE RESULTANT OSCILLATION IN THE TRANSMITTING AERIAL

$$\left.\begin{array}{lll} A_1 = Ae^{-\delta T}; & A_2 = Ae^{-\delta 2T}; & A_3 = Ae^{-\delta 3T}; \\ A_4 = Ae^{-\delta 4T}; & A_5 = Ae^{-\delta 5T}; & A_6 = Ae^{-\delta 6T}; \\ A_7 = Ae^{-\delta 7T}; & A_8 = Ae^{-\delta 8T}; & A_9 = Ae^{-\delta 9T}. \end{array}\right\} \quad (3)$$

If the maximum amplitude obtained in the case of resonance be denoted by R_{max}, there is obtained by substituting the system of equations (3) in equation (1):

$$R_{max} = A + Ae^{-\delta T} + Ae^{-\delta 2T} + Ae^{-\delta 3T} + Ae^{-\delta 4T} + Ae^{-\delta 5T} + Ae^{-\delta 6T} + Ae^{-\delta 7T} + Ae^{-\delta 8T} + Ae^{-\delta 9T} \quad (4)$$

The right-hand member of equation (4) represents the sum of the members of a geometrical progression, the first of which is A—the amplitude of the forced oscillation—while the common ratio of the progression is equal to $e^{-\delta T}$ or $\frac{1}{e^{\delta T}}$

Thus:

$$R_{max} = \frac{A\left(1 - \frac{1}{e^{\delta 10T}}\right)}{1 - \frac{1}{e^{\delta T}}} \quad (5)$$

which could be further simplified.

A much simpler formula can, however, be obtained by taking into consideration the fact that the number of the members of the geometrical progression is, mathematically speaking, not limited, but infinite, the time co-ordinate being the asymptote of the exponential curve and by bearing in mind that the ratio of progression is smaller than 1.

There can be written:

$$\lim_{n=\infty}\left(\frac{1}{e^{\delta T}}\right)^n = 0 \quad (6)$$

and

$$R_{max} = A + Ae^{-\delta T} + Ae^{-\delta 2T} + Ae^{-\delta 3T} + \ldots = \frac{A}{1 - e^{-\delta T}} \quad (7)$$

or

$$R_{max} = \frac{A}{1 - \frac{1}{e^{\delta T}}} \quad (8)$$

$\frac{1}{e^{\delta T}}$ being the ratio between the amplitude of one-half oscillation and the amplitude of the preceding half oscillation of a free oscillation, the conclusion can be expressed as follows:

The maximum amplitude of the resultant oscillation in the case of resonance and when the forced oscillation is undamped is equal to the amplitude of the forced oscillation divided by the difference between unity and the ratio between the amplitude of one-half oscillation and the amplitude of the preceding half oscillation of a free oscillation, irrespective of their signs.

If, for instance, the amplitude A of the forced oscillation is 10 amp and the ratio $\frac{1}{e^{\delta T}}$ above referred to equal to $\frac{7}{8}$, there is obtained:

$$R_{max} = \frac{10}{1 - \frac{7}{8}} = 80$$

That is to say, the amplitude obtained because of the resonance effect is eight times as large as the amplitude of the forced oscillation.

(d) The maximum amplitude R_{max} obtained in the case of resonance may also be determined graphically as illustrated in Fig. 12. Construct a triangle of which the two sides a and b are equal to amplitudes A and A_1, respectively; draw an arc c with the radius A_1, and from the point 1 where it intersects the side a draw a line d parallel to the side e of the triangle; from the point 2 where this parallel intersects the side A_1 draw an arc with the radius 02 until it intersects the side a at the point 3; then continue the construction in the same manner as before until arriving near the point o of the triangle, when it is hardly possible, and as a matter of fact hardly necessary, to construct further points. It can easily be geometrically demonstrated that the distances 00_1, 01, 03, 05, 07, 09, etc., are equal to the amplitudes A, A_1, A_2, A_3, A_4, etc., of the free oscillation.

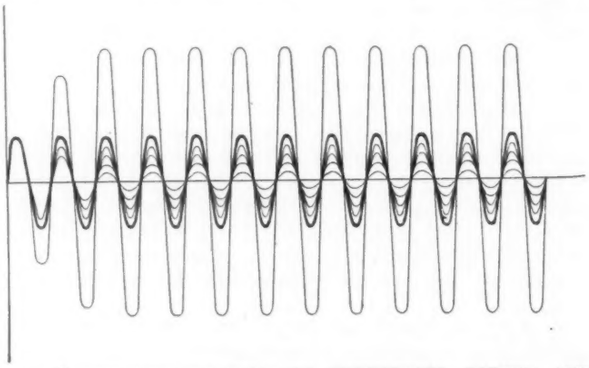


FIG. 9—SECOND EXAMPLE OF SUPERPOSED FORCED AND FREE OSCILLATIONS

The sum of these distances will therefore give the value of the maximum amplitude.

Influence of the damping upon the resultant oscillation.

(a) If the diagram illustrated in Fig. 7 be compared with that illustrated in Fig. 9, in which the amplitude of the forced oscillation is shown as being equal

to that of the forced oscillation shown in Fig. 7, but the free oscillations more damped than those in said figure, it will be noticed that:

The maximum attained in the case of a more damped free oscillation is reached more quickly but is smaller than that attained in the case of a less damped free oscillation.

(b) Comparing together the diagrams illustrated in Figs. 10 and 11 in which the forced oscillation is shown to be damped—in Fig. 10 more damped than the free oscillation and in Fig. 11 less damped than the free oscillation—the damping of the forced oscillation in Fig. 10 being equal to that of the free oscillation in Fig. 11 and vice versa, it will be noticed that:

(1) The increase of the resultant oscillation up to its maximum amplitude is determined by the oscillation with the higher damping, and its decrease from the maximum amplitude to nil is determined by the oscillation with the smaller damping.

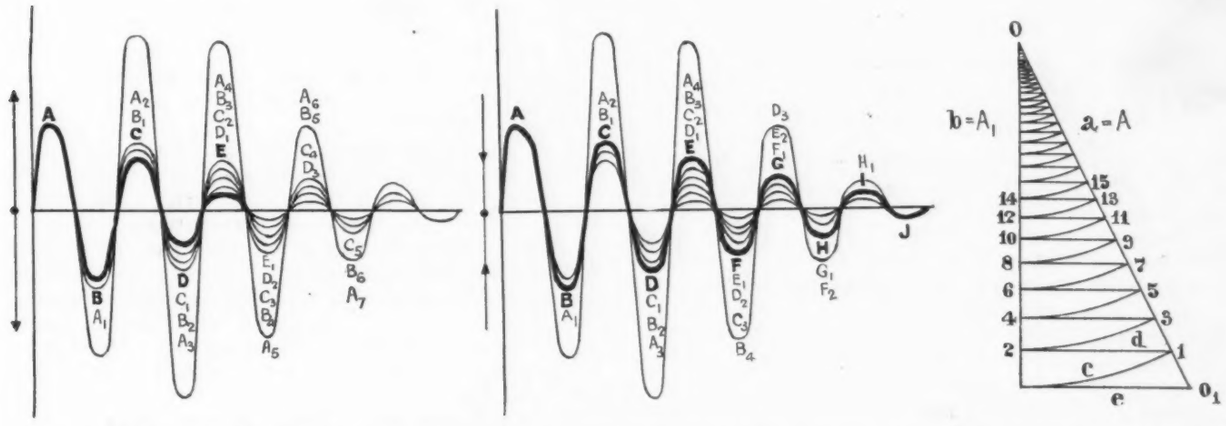
(2) The resultant oscillation obtained by the superposition of damped free oscillations on a forced oscillation which is more damped than the free oscillations is identical with that obtained by the superposition of damped free oscillations on a forced oscillation which is less damped than the free oscillations, provided the forced oscillation takes place. In other words, it may be said that the various amplitudes of the resultant oscillation are equal to A, $2B$, $3C$, $4D$, $5E$, etc., respectively.

Wireless Telegraphy

Resonance in wireless-telegraphy circuits.

Wireless-telegraphy circuits in which high-frequency currents come into play may be classified in three groups, namely, the transmitting circuits, the transmitting-receiving circuits and the receiving circuits. These circuits will here be considered in their order of operation.

Transmitting circuits. The typical connection of transmitting circuits is shown in Fig. 14, in which the closed transmitting circuit C_1 acts inductively upon the open transmitting aerial circuit C_2. These two circuits are said to be in resonance with one another when the free frequency of the circuit C_2 is equal to the frequency of the oscillatory currents through the circuit C_1. Assuming that the condition of resonance is fulfilled, construct the resultant oscillation obtained in the circuit C_2 by the superposition of the free oscillations in the circuit on the forced oscillation induced therein by the oscillatory current in circuit C_1, for the case when the oscillations in circuit C_1 are undamped, and for the



FIGS. 10, 11 AND 12—THIRD AND FOURTH EXAMPLES OF SUPERPOSED FORCED AND FREE OSCILLATIONS AND GRAPHICAL CONSTRUCTION OF R_{max}

damping coefficients of the forced and free oscillations in the one case are identical with the damping coefficients of the free and forced oscillations respectively in the other case.

The curves of the resultant oscillations obtained in Figs, 7, 9, 10 and 11 are given in Fig. 13, which shows at a glance the conclusions referred to under a and b.

(c) *Special case.* It can easily be seen that when the damping coefficients of the primary and secondary circuits, and therefore also the damping coefficients of the forced and free oscillations, are equal to one another there is obtained:

$$A_1 = B;\ A_2 = B_1 = C;\ A_3 = B_2 = C_1 = D;\ A_4 = B_3 = C_2 = D_1 = E \text{ and so on;}$$

That is to say, the amplitude of the forced oscillation is at any moment equal to the amplitude of the free, or of each of the free, oscillations superposed on the particular half of the forced oscillation, and therefore the following conclusion can be drawn:

The resultant oscillation in the case of the superposition of damped free oscillations on a damped forced oscillation when their damping coefficients are equal to one another is obtained by multiplying the various amplitudes of the forced oscillation by 1, 2, 3, 4, 5, etc., according to the position of each half of the forced oscillation in the series of periods during which the case when they are damped, and the ratio between the amplitude of one-half oscillation and that of the preceding half-oscillation is, say, $\frac{24}{25}$, the ratio between the amplitude of one half and that of the preceding half of the free oscillation being in both cases, say, $\frac{10}{25}$.

(1) *Circuit C_1 carrying undamped oscillations.* Assume that the amplitude A of the forced oscillation induced in circuit C_2 is equal to 50 units, and that consequently A_1 is equal to $50 \times \frac{10}{25} = 20$. Construct a triangle a, b, c, as shown in Fig. 8, in which b is at right angles to c and equal to $A_1 = 20$, and a equal to $A = 50$, and then find the subsequent amplitudes A_2, A_3, A_4, etc., of the first free oscillation by the graphical construction explained with reference to Fig. 12. The subsequent amplitudes B, C, D of the forced oscillation being all equal to A (that is, 50 units), and $A_1 = B_1 = C_1$, etc., . . . $A_2 = B_2 = C_2$, etc., . . . this case is identical with that illustrated in Fig. 7, and the maximum amplitude R_{max} is equal to $A + A_1 + A_2 + A_3 + A_4 = 83$. The calculation of R_{max} according to equation (8) gives 83.33 so that the value obtained graphically is sufficiently correct. It is known that R_{max} is at-

tained with A_1—that is, the last half of the free oscillation initiated by the first half A of the forced oscillation—and that this half A_1 of the free oscillation is superposed on the half E of the forced oscillation. It is also known that from the moment R_{max} is attained their maximum is maintained as long as a forced oscillation is induced in the circuit. Therefore it is possible

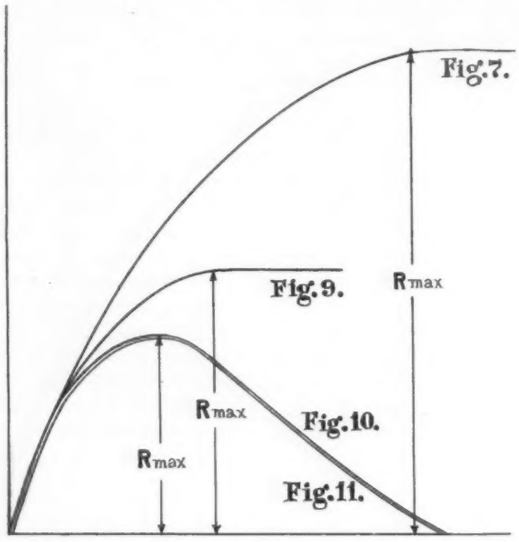


FIG. 13—CURVES OF THE RESULTANT OSCILLATIONS OBTAINED IN FIGS. 7, 9, 10 AND 11

to plot the curve of the resultant oscillation including the amplitudes between the beginning of this oscillation and its maximum, these amplitudes being equal to A; $B + A_1$; $C + B_1 + A_2$; $D + C_1 + B_2 + A_3$ and $R_{max} = E + D_1 + C_2 + B_3 + A_4$.

In Fig. 17, in which the amplitudes are plotted on reduced scale, the straight line I represents the constant amplitude of the forced oscillation and II the resultant oscillation obtained as hereinbefore stated. The increase in amplitude obtained in the example illustrated is 66 per cent of the amplitude of the forced oscillation.

(2) *Circuit C_1 carrying damped oscillations.* It has been assumed that the ratio between the amplitude of one half and the amplitude of the preceding half of the forced oscillation is $\frac{24}{25}$ and that the ratio between two consecutive amplitudes of the free oscillation is $\frac{10}{25}$. Assume further that the first amplitude A of the forced oscillation is equal to the amplitude of the forced oscillation considered under 1; that is, equal to 50 units.

First construct in addition to the triangle a, b, c, a triangle a_1, b_1, c_1, shown in Fig. 8, and make a_1 equal to a and A (that is, 50), and b_1 equal to $50 \times \frac{24}{25}$ (that is, 48), and draw c_1 parallel to c. Allow the point of intersection of the sides a and b of the one triangle to coincide with the point of intersection of the sides a_1 and b_1 of the other triangle.

Next determine the amplitudes B, C, D, E, etc., of the forced oscillation, by means of the triangle a_1, b_1, c_1, and graphical construction illustrated in Fig. 12, and the amplitudes A_1, A_2, A_3, etc., of the free oscillation initiated by A by means of the triangle a, b, c.

Then plot on the side a of the triangle a, b, c, the amplitude B of the second half of the forced oscillation by continuing the arc 1 until it intersects the side, and determine the amplitudes B_1, B_2, etc., of the free oscillation initiated by B, in the same manner as those of the free oscillation initiated by A were determined. Continue in the same manner the determination of the amplitudes of the free oscillations initiated by all the other parts C, D, E, etc., of the forced oscillation. In order to avoid confusion between the many points determined on the side a, draw above the latter a series of converging lines, continue the various arcs 1, 2, 3, etc., beyond the side, until each of them intersects a particular line, and mark the points of intersection with A, B, C, etc., as shown. When the amplitudes of the free oscillations initiated by A, B, C, etc., are being determined by means of the triangle a, b, c, continue the arcs drawn for the determination of A_1, A_2, A_3, etc., until they cut the line corresponding to A, the arcs drawn for the determination of B_1, B_2, B_3, etc., until they cut the line corresponding to B, and so on. In this way the amplitudes belonging to a free oscillation and the amplitude of the forced oscillation which initiated the free oscillation are all on one line on which only these amplitudes are indicated.

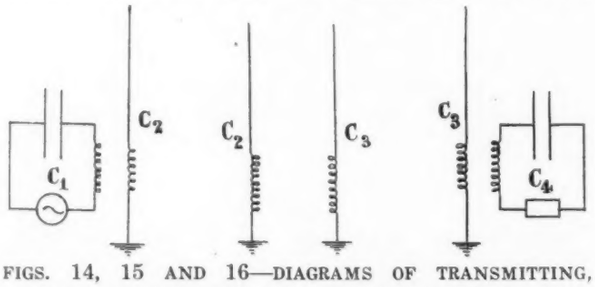
Finally, arrange the various amplitudes determined by the construction shown in Fig. 8 in their proper order of succession and superposition as follows:

$A, B, C, D, E, F, G, H,$
$A_1, B_1, C_1, D_1, E_1, F_1, G_1, H_1,$
$A_2, B_2, C_2, D_2, E_2, F_2, G_2, H_2,$
$A_3, B_3, C_3, D_3, E_3, F_3, G_3, H_3,$
$A_4, B_4, C_4, D_4, E_4, F_4, G_4, H_4,$

and add together all the amplitudes belonging to one and the same column. The values A, $B + A_1$, $C + B_1 + A_2$, etc., thus obtained represent the amplitudes of the resultant oscillation.

In Fig. 17 1 is the curve of the forced oscillation, and 2 the curve of the resultant oscillation obtained in the manner above described. A comparison of curve 2 with curve II obtained in connection with the undamped forced oscillation shows that R_{max}, which in this case has been found to be equal to $D + C_1 + B_2 + A_3 = 74.3$, is attained sooner than in the case of undamped oscillations (compare R_1 with R_1), and that it is not subsequently maintained and is not so high as in that case. In the example above illustrated, the increase in amplitude obtained is 48.6 per cent of the amplitude of the forced oscillation, which, compared with the increase of 66 per cent in the case of undamped oscillations, gives a difference of 17.4 per cent in favor of the undamped oscillations provided the amplitude of the forced undamped oscillation is equal to the first amplitude of the forced damped oscillation, as has been assumed.

Transmitting-receiving circuits. Whatever may be the true explanation of the actual electrical phenomena which take place between the transmitting aerial circuit



FIGS. 14, 15 AND 16—DIAGRAMS OF TRANSMITTING, TRANSMITTING-RECEIVING AND RECEIVING CIRCUITS

C_2 and the receiving aerial circuit C_3 (Fig. 15), one can safely assume that a forced oscillation of the same frequency as the frequency of the resultant oscillation obtained in the transmitting aerial circuit C_2 is induced in the receiving aerial circuit C_3. The two circuits are said to be in resonance with one another if the natural frequency of the circuit C_3 is equal to the frequency

of the resultant oscillation in C_2. Assume that this condition is fulfilled and determine according to the method above described the resultant oscillation obtained in circuit C_2 by the superposition of the free oscillations thereof on the forced oscillation induced therein.

Before determining such oscillation it seems well to make a few remarks with reference to the resultant oscillations II and 2 obtained in the circuit C_2, and as shown in Fig. 17 and with reference to the forced oscillations they respectively induce in the circuit C_2.

In the first instance, it is obvious that because of the great amount of energy dissipated in the surrounding space, only a comparatively very small amount reaches a distant receiving circuit and that therefore the electrical units to be considered in such a circuit are of a quite different order as compared with the electrical units coming into question in the transmitting circuit. Nevertheless, one can assume that the amplitude of the forced oscillation induced in the receiving circuit is at any moment proportional to the corresponding amplitude of the resultant oscillation in the transmitting circuit.

It is also obvious, since some energy is lost between the transmitting and receiving circuits, partly through the air and partly through the ground, and since this loss increases with the increase in the distance between the two circuits, that to each distance between two points where such circuits may be established there must correspond a minimum of amplitude of the resultant oscillation, for the induction of any appreciable energy in the receiving circuit, any amplitude below the minimum producing no effect whatever upon the circuit. Assume that in the example being considered 40 is the minimum amplitude below which no effect can be detected in the circuit C_2. If the line A_{min} in Fig. 17 be drawn to correspond to the minimum of 40, the effective part of the resultant oscillation will be seen at a glance. Thus the resultant oscillation II of the undamped oscillations starts to be effective at the moment II_e and thereafter remains continuously effective, while the resultant oscillation 2 of the damped oscillations starts to be effective at the moment 2_e which coincides

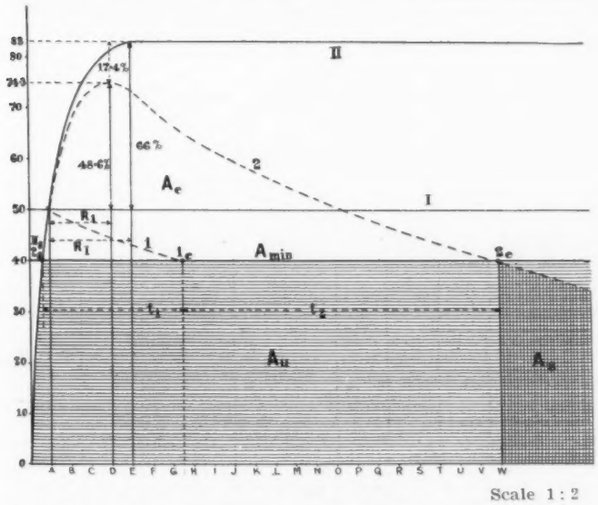


FIG. 17—FIRST COMPARATIVE DIAGRAM OF RESULTANT OSCILLATION CURVES

with II_s and ceases to be effective at the moment 2_e. Moreover, with regard to the resultant oscillation of the damped oscillations, the part of the oscillation beyond the moment 2_e, since it is not effective it constitutes an unnecessary loss. In the diagram the necessarily uneffective part has been indicated by A_u, the effective part by A_e, and the superfluous part by A_s.

Finally if the resultant oscillation 2 be compared with the forced oscillation 1 from which it has resulted by the superposition of the free oscillations when the condition of resonance is fulfilled, it is seen that the resonance phenomenon in the case of damped oscillations not only effects an increase of amplitude in the transmitting circuit, but also a prolongation (t_2) of the time during

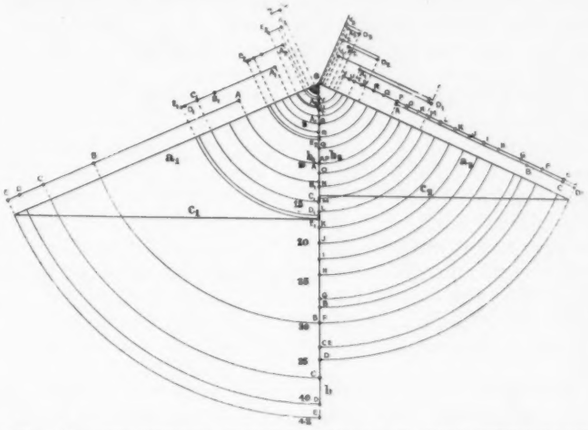


FIG. 18—GRAPHICAL CONSTRUCTION OF THE RESULTANT OSCILLATIONS IN THE RECEIVING AERIAL

which the resultant oscillation produces an effect in the receiving circuit. Indeed, in the example illustrated such time has been more than trebled (compare t_1 with t_2).

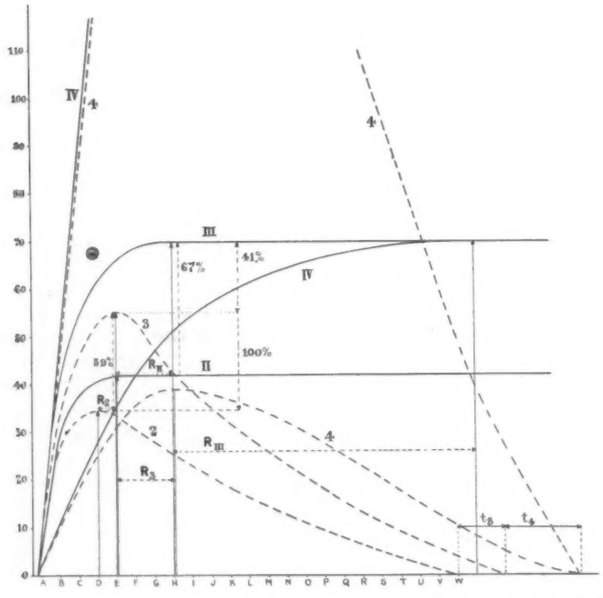
Referring now to the determination of the resultant oscillations in the receiving circuit C_2 when the forced oscillations are undamped and damped respectively, use will be made for this purpose of only those parts of the curves II and 2 which are above A_{min}, assuming naturally that the units of the amplitudes are of a much lower order than the units at the transmitting end.

Plot on a vertical line b (Fig. 18) the amplitudes of the effective parts of the curves II and 2, and mark the amplitudes A, B, C, etc., belonging to the curve II at the left-hand side and the amplitudes A, B, C, etc., belonging to the curve 2 at the right-hand side of the line. Assuming that the ratio between an amplitude and the preceding amplitude of a free oscillation of the circuit C_2 is equal to that corresponding to the free oscillation of the circuit C_1—that is, equal to $\frac{10}{25}$—construct on the left-hand side of b a triangle a_1, b_1, c_1, in which a_1 is equal to the maximum amplitude of the curve II and $b_1 = a_1 \frac{10}{25}$, and on its right-hand side a triangle a_2, b_2, c_2, in which a_2 is equal to the maximum amplitude of the curve 2 and $b_2 = a_2 \frac{10}{25}$, the sides c and c_1 in both triangles being at right angles to b, which coincides with b_1 and b_2. The determination of the amplitudes of the various free oscillations initiated by the half oscillations of the forced oscillation II is then carried out by means of the triangle a_1, b_1, c_1, and those of the free oscillations initiated by the half oscillations of the forced oscillation 2 by means of the triangle a_2, b_2, c_2 in the manner already explained. Because of the great number of points plotted in the proximity of the point 0, it has been found more convenient to use for the points belonging to different groups, instead of converging lines, parallel lines, and as an alternative to the construction shown in Fig. 8 the various points have been grouped in Fig. 18 differently from in Fig. 8, in a manner that will be found self-explanatory.

The amplitudes of the resultant oscillations for the

two cases are found in the manner already referred to in connection with the transmitting circuits; that is by arranging the various amplitudes indicated and determined in Fig. 18 in their proper order of succession and superposition and adding together the superposed amplitudes corresponding to each half-period.

In Fig. 19, II and III represent the forced and resultant oscillations respectively for the case of undamped oscillations, and 2 and 3 the forced and resultant oscillations for the case of damped oscillations. These curves show that the moment when the maximum amplitude is attained in the case of resonance between C_2 and C_3 is in each case retarded with respect to the maximum attained by the resonance between the circuits C_1 and C_2, and in the case of undamped oscillations more retarded than in the case of damped oscillations (compare R_{II} with R_2). They also show that in the case of undamped oscillations the duration of the effective period has again been increased by t_3. Finally they show that the increase in amplitude in the case of undamped oscillations is 67 per cent of the maximum amplitude of II and in the case of damped oscillations 59



Scale, 1 : 5 for Curves IV and 4

FIG. 19—SECOND COMPARATIVE DIAGRAM OF RESULTANT OSCILLATION CURVES

per cent of the maximum amplitude of 2. The maximum of III being compared with the maximum of 2 it is found that the increase is 100 per cent, so that there is a difference of 41 per cent in favor of the undamped oscillations, inclusive of the difference already found in their favor in the transmitting circuits.

Receiving circuits. The typical connection of receiving circuits is shown in Fig. 16, in which the open receiving aerial circuit C_3 acts inductively upon the closed receiving circuit C_4. These two circuits are in resonance with one another when the free frequency of the circuit C_4 is equal to the frequency of the resultant oscillation obtained in the circuit C_3. Assuming that this condition is fulfilled and constructing in the manner above described with reference to the transmitting-receiving circuits, the resultant oscillation obtained in C_4 by the superposition of the free oscillations of the latter circuit on the forced oscillation induced therein by the resultant oscillation in C_3 (by the resultant oscillation III corresponding to the undamped oscillations and by the resultant oscillation 3 corresponding to the damped oscillations), and assuming further the ratio of the amplitudes of the free oscillations in C_4 to be $\frac{20}{25}$ and for the sake of simplicity neglecting the question of coupling, there are obtained the curves IV and 4 shown in Fig. 19 on the reduced scale of 1:5 as compared with the other curves in the same illustration.

It will again be seen that in each case the maximum amplitude has been retarded in the circuit C_4, with respect to the maximum amplitude in the circuit C_3, and more retarded in the case of undamped oscillations than in the case of damped oscillations (compare R_{III} with R_3), and that at the same time the period during which the resultant oscillation of the damped oscillations is effective has been prolonged by t_4. (This period is a little longer than indicated in the diagram, the length of which has been slightly reduced.) A comparison of curves IV and 4 with curves III and 3, respectively, shows that the amplitude has been increased in the case of undamped oscillations by 400 per cent and in the case of damped oscillations by 255 per cent, while the comparison of curves IV and 4 with curve 2 shows an increase of 900 per cent in the case of undamped oscillations and an increase of 457 per cent in the case of damped oscillations. The following is therefore derived:

Assuming the forced oscillations induced in the transmitting aerial to be equal in the two cases, and the condition of resonance to be fulfilled in all the circuits, the increase of amplitude obtained in the last receiving circuit is in the case of undamped oscillations approximately double that obtained in the case of damped oscillations which have the degree of damping above referred to by way of example.

Damped or continuous oscillations.

The question as to whether undamped or continuous oscillations are to be preferred to damped oscillations for wireless telegraphy purposes is of special importance at the present moment. To deal with this question in all its aspects would be outside the scope of this article. However, reference will be made to a few points directly related to or following from the above investigation which have a bearing on the question just raised.

(1) *Detectors, amplitude and persistency of oscillations.*

All the quantitative detectors employed in wireless telegraphy—the word detector being here used in a very broad sense to include not only detectors properly so called but also any equivalent device which enables the high-frequency oscillations in the receiving circuits to effect a change in an indicator—are entirely dependent upon the current or potential amplitude of the high-frequency oscillations, or upon both. Of these detectors, so far as the writer knows, only the thermal detectors, such as the bolometer, depend on both the amplitude and the persistency of oscillations. Under these circumstances it is obvious that the effect produced by undamped oscillations upon a detector of the character last mentioned must be much greater than the effect produced thereon by damped oscillations. However, no thermal detector is known at present having the same great sensitiveness as the magnetic, electrolytic or crystal detector, for which reason thermal detectors are not used in practical wireless telegraphy, and thus, whatever may be gained from the persistency of the undamped oscillations, as apart from their amplitude, is not at present practically gained, and the amplitude remains the only deciding factor.

(2) *Amplitude of forced oscillation.*

It was shown above that the increase in amplitude obtained in the various circuits fulfilling the condition of resonance is dependent, apart from other factors, upon the amplitude of the forced oscillation originally

induced in the transmitting aerial circuit by the closed transmitting circuit coupled therewith. The point which next arises is, therefore, the comparison between the amplitudes of the forced oscillations induced by undamped and damped oscillations respectively as produced by practical apparatus.

(3) *Duration of oscillations.*

It is clear that as soon as the oscillation in the last oscillatory receiving circuit has attained its maximum amplitude—thermal detectors dependent also upon the persistency of oscillations having been excluded for the reason above mentioned—there is no further need to maintain the maximum, since the oscillation has already produced the greatest change in the detector. In the case of damped oscillations, the oscillations begin to die off as soon as the maximum has been attained, as they should, while in the case of undamped oscillations they persist after the maximum has been attained, and this is superfluous. Figs. 20 and 21 illustrate these two cases.* While the duration of a complete resultant oscillation in the case of damped oscillations lasts only for a period of time T_1, the resultant oscillation in the case of undamped oscillations lasts for a period T_2 plus a period T_3, which last period if not interrupted is, so to say, infinite. This period T_3 has a corresponding period in the closed transmitting circuit, and the energy produced in the latter constitutes an unnecessary loss.

(4) *Undamped oscillations and the ticker.*

The use of undamped oscillations in wireless telegraphy has been greatly assisted by the introduction of the ticker in the receiving circuits. The reason thereof will be easily perceived if it is borne in mind that in the case of undamped oscillations as soon as the maximum amplitude has been attained it is followed by a "steady" state which is maintained for the very long period of time T_3, during which no further changes can take place in the detector of such a nature as to cause further changes in the indicator controlled thereby, say in a telephone. The introduction of the ticker in the receiving circuits which intermittently connects a condenser circuit to an oscillatory circuit and to a telephone circuit respectively, so that it is first charged by the one and then discharged through the other, permits, however, the energy present in the oscillatory circuits during the period T_3 to be utilized in an effective manner in the indicating device. Figs. 22 and 23 illustrate by way of example the diagrams of the condenser charge and discharge by means of a ticker operating with two different number of interruptions respectively. In each illustration T_2 corresponds to the time necessary for reaching the maximum amplitude, T_3 the time of "steady" state and T_4 the time during which the condenser is discharged through the telephone, while $T_5 = T_2 + T_3 + T_4$ determines the frequency of the interrupter, which in the example illustrated in Fig. 23 is greater than that illustrated in Fig. 22. The greater this frequency can be made the more will the period of "steady" state T_3 be reduced, and the more will the persistency of the oscillations be utilized in the telephone.

(5) *The problem of interference and musical transmission.*

Various methods of solving the problem of interference have been proposed, but howsoever reliable or promising such methods may be, practical complications necessarily arise as soon as more than two or three stations are in interference. The production of groups of oscillations having a definite note has lately come to the front, and there is now a general tendency to believe that the utilization of such oscillations will lead to a more satisfactory solution of the problem of interference than it has been possible to obtain hitherto. From a theoretical point of view musical notes give a greater scope than resonance effects for solving this problem. The writer is inclined to believe that good practical results may be attained in this direction to a greater extent than can be attained by utilizing resonance effects only.

It can easily be inferred from the above investiga-

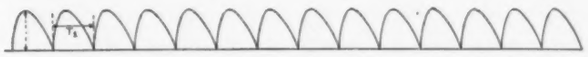


FIG. 20—RECEIVED RESULTANT DAMPED OSCILLATIONS

tion of the resonance phenomenon, and more especially from the resultant curves indicated in Fig. 19 and the diagram illustrated in Fig. 20, that the utilization of groups of oscillations, the groups having a frequency ranging up to about 30,000 cycles per second, and the high-frequency oscillations ranging between the ordinary limits, can give a true musical note, the frequency of which is determined by the frequency of the groups and the modulations by the resultant curve of the high-frequency oscillations, which resultant is in its turn obtained by the utilization of resonance phenomenon.

Any important use of resonance phenomenon in the

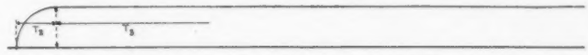


FIG. 21—RECEIVED RESULTANT UNDAMPED OSCILLATIONS

direction just indicated ought to be determined by the transmitting circuits rather than by the receiving circuits, so that the modulations of the note heard at the receiving end should correspond to the character of the particular transmitter, not to that of the receiver.

The diagrams illustrated in Figs. 21 to 23, which refer to undamped oscillations, show on the other hand that one can obtain a musical note with such oscillations only by interrupting their persistency, and as this interruption takes place at the receiving end, the note follows the character of the receiver and not that of the transmitter.

The above comparisons between damped and un-

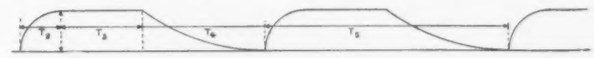


FIG. 22—DIAGRAM SHOWING THE EFFECT OF THE TICKER

damped oscillations lead to the following conclusions.

The increase in amplitude due to the utilization of the resonance phenomenon is theoretically greater in the case of undamped oscillations than in the case of damped oscillations, but this increase is neutralized in practice by the greater amplitude which is primarily produced in the apparatus for undamped oscillations.

The persistency of the undamped oscillations, as apart from their amplitude, cannot at present be practically utilized to give greatly enhanced effects at the receiving end, and such persistency is accompanied by a greater or smaller loss, according to the frequency of the ticker.

FIG. 23—DIAGRAM SHOWING THE EFFECT OF THE TICKER OPERATING AT A HIGHER FREQUENCY

The production in the case of damped oscillations of a musical note at the transmitting end by the utilization of groups of oscillations determining the frequency of the note and by the utilization of the resonance phenomenon determining the modulations thereof constitutes at the same time a solution of the problem of interference.

*Fig. 20 is not strictly accurate, since in the usual apparatus employing damped oscillations there is a time of rest between the end of each resultant oscillation and the beginning of the subsequent resultant oscillation.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

Prize Contest for Central-Station Advertisements

To stimulate the interest of the public in its service, the Stockbridge (Mass.) Lighting Company has offered a series of cash prizes for the best suggestions received for the text matter and make-up of its local advertisements. Any one may compete, and the awards are: first prize, $5; second prize, $3; third prize, $2. It is expected that school-children and others will enter the contest and will be thereby encouraged to ask for information regarding electric service. The company's announcements of the offer refer contestants to its offices for all details, and it is believed that in this way a large number of prospective users will be put in touch with the new-business department.

Motor Drive in the Pearl-Button Industry

In the factory of the Hawkeye Pearl Button Company at Keokuk, Ia., sixty-five speed lathes are in daily operation cutting circular disks from musselshells. These "blanks," as the disks are called, vary in diameter from about 0.375 in. to 1 in. and with the factory operating nine hours a day the sixty-five lathe operators turn out 9 tons of blanks a week.

SPEED LATHE IN PEARL-BUTTON FACTORY

Sorting of the shells so that the larger disks may be turned from the heavier shells is accomplished by a set of revolving non-parallel rolls which allow the smaller shells to drop between the rolls at one end but carry the others to wider openings. This classifier and the sixty-five small lathes are driven by one 20-hp, 440-volt, twenty-five-cycle, three-phase induction motor receiving energy from the mains of the Keokuk Electric Company. The average energy consumption for this motor is 1200 kw-hr. a month, and on this basis it will be seen that a ton of blanks can be turned out with an energy consumption of 75 kw-hr., including all losses in the line shafting.

In conjunction with the button plant a shell crusher operated by a 25-hp motor grinds 25 tons of shells a day. Not all of these shells come from the Hawkeye factory, some of them being shipped in from other places. This grinder is not operated in the summer, as there is little demand for crushed shells when the weather permits barnyard fowls to be kept out of doors.

Electric-Sign Activity at Springfield, Ill.

Within the last year eighty new electric signs have been connected to the mains of the Springfield (Ill.) Light, Heat & Power Company through the joint efforts of the new-business department and salesmen of sign manufacturers. Tungsten lamps were used in all displays. The average of these signs carried 120 5-watt lamps. To the co-operative scheme, by which the local solicitors first created interest among prospective customers, later turning them over to an experienced sign salesman to close the contract, is attributed much of the credit for the record of "more than one sign sale a week."

Electric Cooking as an Off-Peak Load

At the January meeting of "The Point Fives," an organization of English central-station managers who are seeking to bring about wide use of electricity through establishing a uniform low rate of "point five" penny (0.5 d., equivalent to 1 cent) per kw-hr., one speaker during the discussion alluded to the danger of superimposing the electric cooking load upon the lighting peak. To this objection Mr. A. Hugh Seabrook replied that the foregoing comment aptly expressed the usual fear of those who have had little or no experience with cooking loads. He mentioned the case of Herstmonceux, where a 60-kw plant dealt with a lighting load on which during the past twelve months there had been superimposed a cooking load connection of about 75 kw. In spite of this increased connected load the 60-kw plant was able to handle the total peak without difficulty.

Electric Tire Pumps in Garages

An additional argument for central-station service is suggested by the large number of gasoline engines displaced on account of their noisy operation by electric motors in towns where all-day electric operation has recently become available. At Mount Sterling, Ky., the Kentucky Utilities Company has put twenty-four-hour service into effect and has succeeded in equipping most of the local energy-consuming industries with motors. Commenting on this fact, the Mount Sterling *Advocate* remarks: "Stone & Flora have at their garage a motor to take the place of the gasoline engine formerly used to pump up their air tank. This motor will do away with the noisy exhaust." Among the industries which the central station is now serving are the Star Planing Mill Company, the McCormick Lumber Company and the Farmers' Tobacco Warehouse Company.

The Cost of Home Garaging for Electric Pleasure Vehicles

Quoting from the results of tests made some time ago in a public garage in St. Louis, Mr. C. E. Michel, of the Union Electric Light & Power Company, gave the average upkeep for an electric-pleasure vehicle in a garage as $14.98 a month (exclusive of the cost of electrical energy). The test was conducted under Mr. Michel's supervision on twenty pleasure vehicles irrespective of make or equipment. Some were equipped with solid and others with pneumatic tires, while all had lead batteries. In the term "upkeep" are included all repairs, painting, tire and battery renewals and other "little extras" which Mr. Michel says the garage man adds; but, as above noted, the cost of charging was not included.

In connection with these figures Mr. Michel says that it is his firm belief that this upkeep cost may be reduced one-third if the car is kept at home. In this statement he adds that he assumes the owner of the car knows little or nothing about an electric vehicle and will not give it especially good treatment. In view of the facts shown in the above tests Mr. Michel thinks that the figure of $23.50 recently given by the Electric Vehicle Association of America as an average monthly cost for upkeep and energy is conservative.

Factory-Lighting Campaign in Chicago

As the result of a determined effort made by the Commonwealth Edison Company, Chicago, to secure a larger factory-lighting load more than 2000 units have been installed recently in installations ranging from 5 to 150. The fixture which the company is using for this campaign (Fig. 1) is equipped with a shallow enameled-steel reflector with an adjustable collar. Since the tungten lamps contained in it are renewed by the company, a lock socket is supplied with the unit, the conduit serving as the fixture stem and socket support. The lamps are furnished in 100-watt, 150-watt or 250-watt sizes as is desired by the customer.

FIG. 1—LIGHTING FOR BUFFERS AND GRINDERS

According to the form of contract under which these small factory-lighting customers are solicited, the charges are divided into three parts—a rental charge, a maintenance charge and a charge for electrical energy. The patron pays a rental charge of 25 cents a month a lamp and a maintenance charge of 25 cents a month, except during the months of June, July and August, in addition to the company's regular rates for energy. During the summer months the maintenance charge is discontinued, as there is a tendency on the part of manufacturers to argue against the charge at times when the lamps are not used. However, the lamps are given their regular cleaning every ten days in the summer as well as at other times, it being thought best

FIG. 2—A WELL-LIGHTED WORK BENCH

to prevent the accumulation of dirt. No special force of men has been necessary for this work of maintenance as yet, the street-lamp men taking care of all units in operation.

At the end of the initial two-year period the installation reverts to the customer, and from then on he may, if he so desires, maintain his own fixtures or may continue to pay the maintenance charge, for which the company will renew the lamps and clean the fixtures as under the previous arrangement.

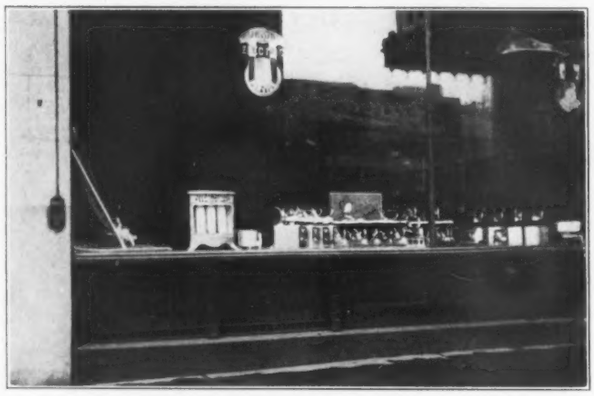
Chicago is at present divided in three districts, each of which is in the hands of a special factory-lighting solicitor employed by the electric-service company.

FIG. 3—GENERAL VIEW OF LOFT LIGHTING

Contracts turned in by these men are submitted to the company's illuminating engineers, and an effort is made to supply the factory owner with the correct amount of light properly distributed. Within the next year the company confidently expects to install approximately 10,000 of these fixtures, and at present the outlook for such a record is promising.

Getting Motion Into a Flatiron Display

The value of moving objects to attract attention to window displays has long been recognized, and a novel application of this principle was embodied in a window recently arranged by the Union Electric Light & Power Company, St. Louis, Mo. An ironing board with a



MOVING IRON DISPLAY, ST. LOUIS, MO.

0.5-in. slot lengthwise through its center was placed in the window and beneath it was hidden a 0.25-hp motor and a system of disks, sewing-machine belts and connecting rods to change the motor's rotary motion to reciprocating movement. By extending the lever connection through the slot in the board an electric iron was made to move along the surface much as if it were driven by an unseen human hand. Various styles of irons arranged in the foreground of the display showed those who stopped to watch the number of types of irons the electric-service company was offering to its patrons.

Wall Cabinets for Unwired Houses in New Orleans

The New Orleans Railway & Light Company is meeting with encouraging success in installing electric wall cabinets in unwired houses, and expects during the next few months to take on in this way several thousand additional customers who cannot afford the first cost of a regular wiring installation. As described in the *Electrical World* of Dec. 13, 1913, the cabinet consists of a meter board, fuse block and run of molding, with outlets for a lamp, electric iron, fan or other appliance. To install, it is only necessary to run the service wires through the outside wall and hang the cabinet in place.

A special offer is now being made by the New Orleans company, which for $9 will install a wall cabinet, a 32-cp tungsten lamp and a $3.50 electric iron with 6 ft. of flexible cord. If desired, the customer may pay on the instalment plan—$3 down and $1 monthly. In this way, with an outlay of only $9, and that on easy terms, electric service is made available in houses where the occupant is not willing to defray the cost of a permanent wiring installation.

Electric Service for Vehicle-Battery Charging

A recent announcement made by the Commonwealth Edison Company of Chicago, through Mr. George H. Jones, power engineer, mentions several modifications which the company is effecting in its rates and methods of furnishing electric service for charging the storage batteries of electric vehicles. For example, the maximum price for energy used in public garages for charging storage batteries has been reduced from 5 cents to 4 cents per kw-hr. This is with the stipulation that no charging be done between the hours of 4 p. m. and 8:30 p. m. during the months of November, December, January and February. Even in those months, however, charging can be done between 4 p. m. and 8:30 p. m. on Sundays without the usual "peak" demand charges being made.

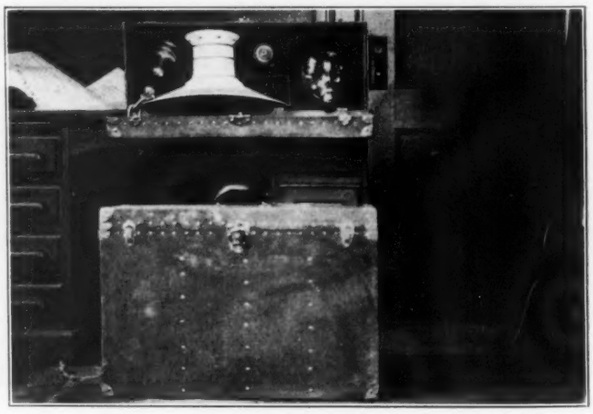
Energy used during the "off-peak" period will be billed monthly instead of on the yearly basis. This will make a considerable reduction for large garages where the maximum demand may vary considerably from month to month. The Commonwealth Edison Company is arranging to install in several of its substations in the outlying districts of Chicago facilities for giving a booster charge of 200 amp. This announcement is of importance to those interested in the use of large trucks. The company solicits suggestions from owners and operators of electric vehicles as well as from the proprietors of public garages in relation to any method which it can adopt to further the electric-vehicle business.

A Slogan Sign for a Town of 2500

The Fulton (Ky.) Electric Light & Power Company has arranged with the local business men's association to pay half the cost of installing and maintaining a large electric sign which is to be used to advertise the advantages from a business standpoint, of the community. The sign will be placed opposite the Illinois Central Railroad station. The Fulton central-station company is improving its plant in a number of ways. New steam lines are being put in, the floors are being concreted, and other changes for the better are being made.

Showing the Customer the Difference

Introduction of the sample-case idea into the sale of electric fixtures for indoor and outdoor illumination is one of the latest selling schemes originated by the new-business department of the Union Electric Light & Power Company at St. Louis, Mo. The case itself, as shown in the accompanying illustration, has its interior divided into four compartments of sufficient size to contain respectively a hanging base and chain, a white-



SALESMAN'S "WHITE WAY" SAMPLE-CASE

enameled steel shade, a 250-watt lamp and a 500-watt lamp. Use of the case has two advantages—first, to the salesman there is given something concrete to talk from, and, second, he has with him the apparatus to demonstrate to the customer the difference between the 500-watt lamp and the 250-watt lamp.

Illumination and Wiring

New Lighting System for Pennsylvania Avenue, Washington, D. C.

On Jan. 30 148 new street lamps were put into service on Pennsylvania Avenue, Washington, D. C., between the Capitol and the Treasury. The installation of the present lighting system is the first step in the movement toward making Washington one of the best lighted cities in the world. The new lamps, one of which is shown in the accompanying illustration, are spaced 100 ft. between centers along the curb, being so staggered that they are placed at intervals of 50 ft. along the street. By this arrangement the lamps form the four corners of an equilateral rhombus, the width of the street being approximately the same as the spacing of the lamps along the curb. The lamp standards, which were especially designed for Washington and are similar to those in use around the Union Station, are made of iron with an oxidized copper finish. Each carries a 6.6-amp, 520-watt General Electric luminous-arc lamp giving 1500 cp at the angle of maximum intensity. The alabaster diffusing glass globe, manufactured by the Tiebot-Gleason Company, Brooklyn, N. Y., is made up of twelve segments and has a transmission coefficient of 66.6 per cent, which makes the combination arc and globe give approximately 1000 cp. The lamps formerly used gave 700 cp and were not incased in diffusing globes.

The cost of the lamp standard was $26.90 and that of the diffusing globe $40.50. It was owing to this high initial cost that the globe was made in twelve segments so that when one is broken it can be replaced at a relatively small expense. The lamp standards and the globes are the property of the District of Columbia, and the arc lamps were furnished by the Potomac Electric Power Company as part of its equipment. The lamps are operated by Brush arc machines, which have been rewound for 6.6 amp. The system will be operated 3942 hours per year, only half of the lamps being in use after 1 a.m.

NEW LIGHTING UNIT ON PENNSYLVANIA AVENUE, WASHINGTON, D. C.

On the evening of Jan. 30 the old lamps were lighted as usual at 5:30 o'clock and were burned until 7:30, when they were all extinguished. For several minutes the avenue then remained in darkness, until at a signal from Mr. W. C. Allen, electrical engineer of the District of Columbia, the new lamps were turned on.

Concrete Pole Butts

BY THOMAS H. ARNOLD

A few years ago when the writer was in charge of electrical work for an industrial company in the Southwest he made some interesting experiments on the use of concrete butts on wooden poles. Climatic conditions

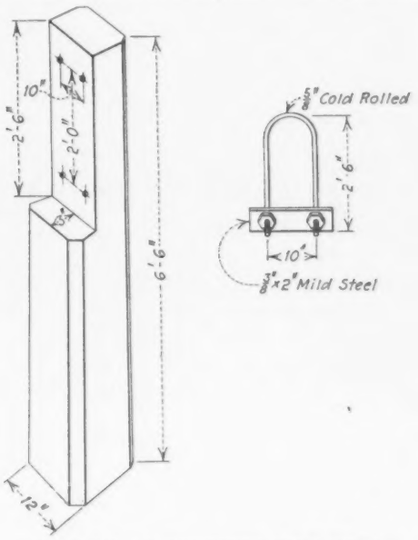


DIAGRAM OF CONCRETE POLE BUTT

there are very favorable to a long life with this type of construction. The air is very dry, rains are infrequent, and the soil is usually rather impervious to water. The alkali in the soil in many places causes, however, a very rapid rot to set in. The life of an untreated pole will thus sometimes be as short as four years and is seldom more than six years. Treated poles last somewhat better, but if the treating has not been thoroughly done rot sets in under the outer shell and the treating is of no value. This rotting frequently starts in the weather and shrinkage cracks which seem to be unavoidable in the Southwestern climate.

Above the ground the pole shows every evidence of long life. A great many poles along railway lines were examined, some being native pine and cedar which had been set for more than twenty years. While the outside revealed considerable weathering, the center of the pole always showed sound wood. The weathering seldom went deeper than 1 in. These poles had all been cut off and reset several times, a fact which seemed to indicate that if some reasonably cheap method of keeping the poles out of the ground were devised a very long life could be expected from a comparatively cheap pole. Also, poles could be reset to the same height in taking care of renewals on existing lines.

The butt as designed was to take care of a pole 30 ft. or less in height, supporting a fairly heavy transmission line. It was employed as a general renewal butt and has also been used on a 35-ft. pole with the full length of pole set on it carrying three No. 8 wires.

As used the butt consisted essentially of a 12-in. by 12-in. column 6 ft. 6 in. long with beveled edges. At the top end one face was cut back 3 in. for a distance of 2 ft. 6 in., leaving a ledge for the pole to rest on. Four 11/16-in. holes were left in the butt for the U-bolts to go around the pole. A small amount of framing was necessary to make the pole fit the butt.

The form work required for this butt is very simple. Reinforcing in the shape of round and square bars was used. Six ⅜-in. bars bound with No. 8 steel wire were arranged about 1 in. from the outer edges, and one ¾-in. bar was placed in the center. This undoubtedly gave

a much stronger pole than was necessary and could have been very much reduced. Some of the butts were however, put into use within two weeks after being poured, so that the extra strength was needed in these cases.

The cost of manufacture per butt was approximately as follows:

Sand	$0.15
Gravel	0.15
Cement	0.50
Reinforcing	1.60
Forms (pro rata)	0.30
Labor and supervision	0.30
	$3.00

The butts described were made in comparatively small quantities and at odd times, which considerably increased their cost. The forms can be used indefinitely, depending on the design and material used. The butts are practically indestructible and are much more readily handled than concrete poles. The poles can be set with the butts very quickly and with about the same number of men required to place them in the ground.

The design used has apparently given the results required and promises a cheap, long-lived construction at a very low cost. It has also enabled the resetting of a number of poles which otherwise would have been too short for use.

Revising the Lighting of a Composing Room

The accompanying illustrations show the results accomplished through a revision of the lighting arrangements in the composing room of the Stromberg-Allen Company, printers, Chicago, where the former system of drop-cord units was replaced with ceiling reflector lamps giving a clear overhead space.

The original installation consisted of a miscellaneous lot of 16-cp and 32-cp carbon-filament lamps hung on drop-cords and inclosed in tin shades. These lamps represented a connected load of about 4400 watts. The new arrangement employs thirty 100-watt tungsten

FIG. 1—COMPOSING ROOM LIGHTED BY DROP-CORD UNITS

lamps, besides three smaller 60-watt units, making a total load of 3180 watts.

Four different types of X-ray reflectors were specified to care for the widely varying requirements of the work done in different parts of the composing room. The proof press, for example, required a strongly concentrated illumination, while on the other hand the type cases demanded more distributed lighting. With the reflectors all mounted at practically the same height—within a couple of feet of the ceiling—these varying illuminating effects were accomplished by suitable choice of the focusing characteristics of the reflectors, after having determined the individual requirements of each position.

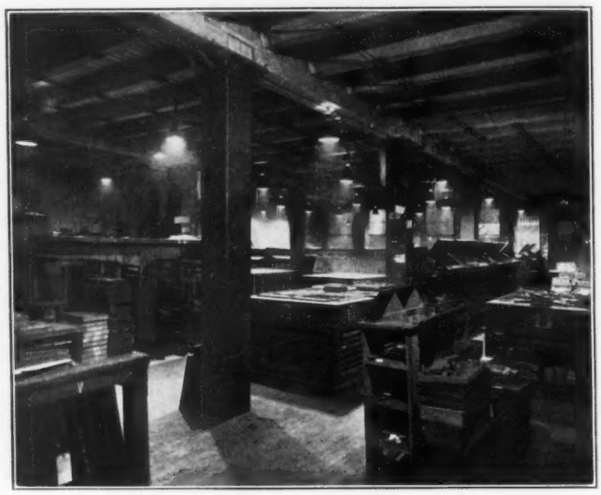


FIG. 2—SAME ROOM RE-EQUIPPED WITH CEILING REFLECTOR LAMPS

Photometer tests of the intensity of illumination obtained have not yet been made, but visual examination indicates that whereas the former average intensity on stones and cases was about 1.5 ft.-candles, with an expenditure of 4400 watts, the present mean illumination is about 4 ft.-candles in return for only 3180 watts.

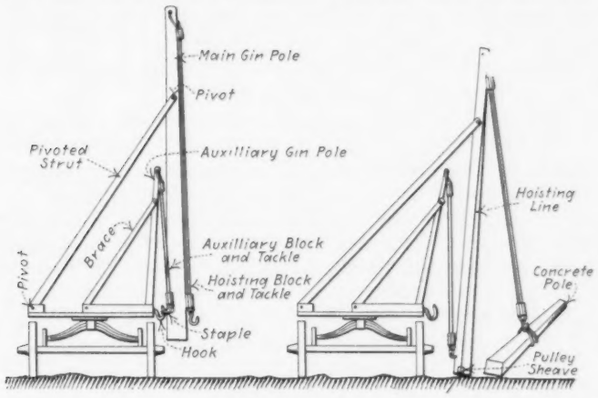
In making the change to the ceiling system some of the old drop-cords were shortened and used, while for holding the large reflectors special stem supports were employed.

Gin-Pole Wagon for Erecting Concrete Poles

Described and illustrated herewith is a light-weight gin-pole wagon which can be drawn up at the roadside to set heavy concrete poles without obstructing the thoroughfare as would an ordinary portable gin-pole. When not in use the gin-pole is supported vertically at the side of the wagon, but when a post is being erected the base of the gin-pole rests on the ground. Since it is not subjected to excessive strains, the wagon itself can be constructed of lighter material than is usually employed in vehicles used for this purpose. With this pole-erecting outfit and a construction gang consisting of two men and a driver thirty to forty 1-ton concrete posts can be set in seven and one-half hours. Considerable time is also saved in moving from one pole-hole position to another because of the construction of the wagon.

Fig. 1 shows a cross-section of the wagon with the gin-pole supported at the side and ready to move to the scene of the job. The gin-pole is hinged at a point two-thirds of its height to a pair of wooden struts, the lower ends of which are spread apart and pivoted to cross-beams on the wagon body. Near the lower end of the gin-pole is a heavy staple which fits over a hook at the side of the wagon supporting the pole when the wagon is being moved along the road. A block and tackle fastened to a small auxiliary gin-pole braced as shown is provided for raising the main pole off the hook and

lowering it to the ground. Fig. 2 shows the gin-pole in position to set a post. Double-pulley blocks and tackle attached to the top of the main gin-pole are used to erect the concrete posts. The free end of the hoisting line from the upper sheave is passed through a pulley block strapped to the lower end of the gin-pole and can be pulled by one of the horses drawing the

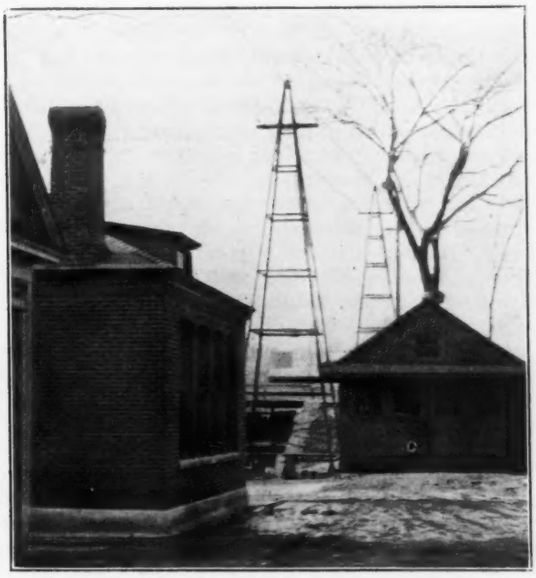


FIGS. 1 AND 2—GIN-POLE READY FOR TRANSPORTATION AND IN POSITION FOR ERECTING POLE

wagon. The pole wagon described is in use by the Consolidated Gas & Electric Company, Baltimore, Md.

A Steel Tower Line for Factory Use

At the plant of the Coes Wrench Company, Worcester, Mass., a 1300-volt loop line is run between the main substation of the company and a new factory owned and operated by the concern some 1760 ft. distant from the original shop. The line runs on the company's own property throughout its route, but traverses the edge of



FACTORY STEEL-TOWER LINE AT WORCESTER, MASS.

a stream which afforded no possibility of using wooden poles. The difficulty was overcome by installing four steel towers between the two plants and setting these on spread concrete foundations, the towers being about 40 ft. high and carrying a three-phase circuit as shown. Energy for the operation of the two factories is supplied by the Worcester Electric Light Company.

Recent Telephone Patent

William Kaisling, of Chicago, Ill., is the inventor of an improved transmitter of the inverted solid-back type, The movable electrode is affixed solidly to the bridge. The front electrode, having a granule chamber, is secured to a flat spring which is mounted on the bridge piece. The usual rigid attachment to the main diaphragm is replaced by a spring tripod, the center of which is secured to the button and the legs of which rest upon the diaphragm.

Letters to the Editors

The Highest Voltage

To the Editors of the Electrical World:

SIRS:—In your issue of Jan. 3, 1914, you state that the Big Creek transmission system, 240 miles in length, operated at 135,000 volts, is the longest line for the highest voltage ever utilized. In this connection I wish to call your attention to the fact that the transmission system of the Southern Sierras Power Company has now been in operation for nearly a year. This system transmits energy from Bishop to San Bernardino, Cal., by direct line, the length of the line being 238 miles, and it has been designed for an emf of 150,000 volts. It is of interest also to note that this latter system, which represents the most recent electrical development, employs the outdoor substation and is controlled exclusively by air-break circuit-breakers.

San Francisco, Cal. AUG. J. BOWIE, JR.

World's Longest Transmission Line

To the Editors of the Electrical World:

SIRS:—Referring to the editorial in the *Electrical World* of Jan. 10, 1914, on the "World's Longest Transmission Line," we would call your attention to a criticism of the use of synchronous condensers which is evidently based on an erroneous view of their function in that plant. The condensers are not installed to compensate for the capacity effects of the line, as stated in the editorial, and any use of this kind made of them is incidental. The condensers are used because without them the cost of the line would have been greatly increased to give the degree of regulation absolutely necessary for proper commercial service. We would especially point out that the line capacity is not an important factor as regards regulation, and that the condensers would still be necessary had the line no electrostatic capacity. That is to say, the condensers are included as an integral part of the design, because economy has been obtained in the design as a whole through their use.

DWIGHT P. ROBINSON,
President and General Manager Stone & Webster Engineering Corporation.

Boston, Mass.

[The fact that the synchronous "condensers" would be of value in improving the voltage regulation of the Big Creek system was mentioned in the concluding sentence of the editorial referred to by our correspondent, the inference being that this use of the machines was an incidental rather than the most important function. Our correspondent states that for the 240-mile, 150,000-volt Big Creek system synchronous condensers furnish the best and cheapest form of voltage regulation quite irrespective of any question of capacity in the line. Transmission engineers have not usually designed and operated their

systems in accordance with this point of view. Such apparatus has, of course, been used previously for regulating purposes, but so far as we are aware, the Big Creek system is the first installation in which the prime function of the synchronous condensers is the maintenance of the proper delivered voltage, the advantages of improved power-factor by compensation for the excess wattless component of the current being considered incidental. The operation of the condensers on this system will be watched with much interest by all transmission engineers.—EDS.]

Standard Sizes of Catalogs

To the Editors of the Electrical World:

SIRS:—Most catalogs at the present day are valuable and are supplied to a carefully selected list of men to whom their contents will be of practical assistance. In the engineering field particularly a great reliance is placed on the file of catalogs maintained, which in effect becomes a reference library. In full recognition of this condition, many of the larger firms have their high-salaried engineers devote considerable time to providing the most valuable information in a lasting form. An attractive booklet reaching the desk of the general manager or purchasing official is much appreciated and after examination is placed on file.

The files of a busy man are carefully maintained and arranged for prompt reference. If the attractive catalog of the manufacturer is of the size generally favored, its filing is a matter of routine and a place is ready to receive it. If, however, it is larger than the other books in the file, there is no specified place that it will fit and the chances of its being thrown away are greatly increased. It may be thrown into a pile with similar odds and ends, where it soon becomes frayed and is destroyed at the next cleaning up.

When one considers the multiplicity of sizes of catalogs in use to-day, the advantage of a standard size is at once demonstrated. A committee appointed by the Technical Publicity Association to investigate and recommend standard sizes for catalogs recently measured 927 catalogs and found 147 different sizes, ranging from 3 in. by 5 in. to 11 in. by 14¼ in.

An argument advanced against uniform sizes of catalogs is that individuality would be sacrificed if all catalogs were uniform. A freak size does not tend toward individuality, but lessens the chance of the catalog being retained by the recipient. If individuality be desired, this can be provided on the inside pages and the cover. A catalog is not for the purpose of exhibiting the individuality of the house publishing it, but to give such information to customers as will be most useful to them.

This matter has been under investigation by the committee of the Technical Publicity Association for the past eighteen months, and its investigations have led to the recommendation of 6 in. by 9 in. and 8½ in. by 11 in. as standard sizes for all purposes. Both of these sizes can be cut to very good advantage with a minimum of waste of material from catalog papers now carried in stock by paper manufacturers. Another advantage of the larger size is that catalogs of these dimensions can conveniently be filed with correspondence, as this size will fit standard filing cabinets.

For paper-bound catalogs the cover should be trimmed to the exact size of the inside pages. Deckel edges and overlapping edges make catalogs less convenient to handle and should be discouraged.

For catalogs with stiff covers the inside pages should be trimmed to the sizes recommended, that is, 6 in. by 9 in. and 8½ in. by 11 in., with an overlap of ⅛ in.

This committee also recommended 8 in. by 10½ in. for bulletins, and this size was accepted by the Technical Publicity Association at its meeting on Oct. 9, 1913, because a large number of companies are now using a letterhead of this size and because bulletins frequently accompany letters and are filed with correspondence. This size is also the one that has been recommended by the Master Car Builders' Association as a standard for letter paper and specifications. When binders are furnished for bulletins they should be 8½ in. by 11 in. In this way they will be uniform with the 8½-in. by 11-in. catalogs and can be filed with them.

While the 9-in. by 12-in. size has been recommended by the Technical Publicity Association for technical and trade journals, it is not recommended as a standard for catalogs.

The report of the Technical Publicity Association is the same in all respects as the reports of similar committees appointed by the American Society of Mechanical Engineers and the American Institute of Architects, except that these committees recommended the 8½-in. by 11-in. size for both bulletins and catalogs.

It is to be hoped that all manufacturers will adopt these standards for all future catalogs and bulletins.

ARTHUR HALLER,
Secretary Technical Publicity Association.

New York.

Boilers Arranged for Quick Firing

To the Editors of the Electrical World:

SIRS:—I note in your issue of Jan. 24 a letter from Mr. B. W. Dennis with reference to the method of maintaining hot water in emergency boilers with tank and heating coil, as described in the Dec. 6 issue. He suggests that some of the expense and complications of installing the heating coil in the blow-off tank might be eliminated, and recommends that the live steam be injected directly into the bottom of the rear header or mud drum of the boiler. The injection of this quantity of steam directly into the boiler would localize the heat at the point of injection to such an extent that there would be a very objectionable water hammer. Aside from this, connecting up a jet of steam to each boiler would entail much piping and many valves, which would require much care and attention in shutting the boiler off in an emergency. With the tank system there were no extra connections made, and in case of emergency when the boilers are required the only valves to be shut are the blow-off valves.

The function of the tank and coil is to absorb the heat supplied in the live steam and impart it to the cool water slowly. This sets up a slow circulation, maintaining a high temperature without the danger from water hammer. It should be understood that the steam used for heating this water was a part of the steam-header condensation drainage, which is necessary as the headers are kept alive for emergency.

I take this opportunity to make a correction in the initial article. The 12½ lb. of coal per day noted therein should read 12½ lb. of coal per hour, and is comparable with the 130 lb. per hour noted as necessary for maintaining a hot bank. This was a typographical error.

Mr. Dennis also speaks of the use of fuel oil for aiding in bringing up an emergency boiler. We have found that the expense for fuel when using oil burners for this purpose is considerably greater than with the other method, and that there is nothing gained in the length of time required for bringing the boiler on to the header.

JOHN HUNTER.

St. Louis, Mo.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

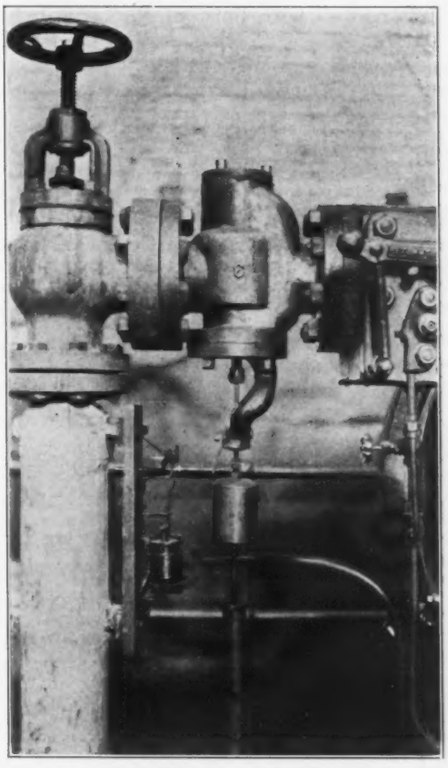
Electrically Operated Pumping Station for Boston Fire Service

The city of Boston, Mass., has awarded to the Westinghouse Electric & Manufacturing Company a contract for the equipment of a high-pressure electrically driven pumping station to be established in the heart of the city for use in fire fighting. The installation is to be completed in about a year. The station will be erected on Charles Street, between Boylston and Beacon Streets, and will be equipped with six six-stage centrifugal pumps, each of which will be capable of delivering 3000 gal. of water per minute against a discharge pressure of 300 lb. per sq. in., when operating at a speed of about 700 r.p.m., with a suction pressure of 40 lb. per sq. in. Each pump will be directly connected at one end to a 700-hp, 6600-volt, sixty-cycle induction motor, and at the other end to an 800-hp, 13,200-volt, twenty-five-cycle induction motor. Energy for the operation of the plant will normally be taken from the sixty-cycle and direct-current distribution systems of the Boston Edison company, the twenty-five-cycle service being of an emergency character and supplied from the South Boston station of the Boston Elevated Railway Company. The direct-current service will be supplied at 110 volts and 220 volts and will be employed in the operation of auxiliary motors and control apparatus.

The station will be built to house eight units, and there will be three independent sixty-cycle feeders, one twenty-five-cycle and two direct-current feeders. The building is to be laid out with a high-tension room divided into compartments housing busbars and switching appliances for the sixty-cycle and twenty-five-cycle systems, the secondary controlling equipment and resistances. On the sixty-cycle system the busbars are to be split into three sections and on the twenty-five-cycle system into two sections, with non-automatic switches between, each section being designed so that it can be operated singly or collectively as a common bus taking energy from one or more lines as may be desired. Oil switches will be of the electrically operated, remote-control type, capable of being opened or closed by hand and of interrupting a short-circuit of 100,000 kw on the sixty-cycle system and 45,000 kw on the twenty-five-cycle system. The wiring will be arranged so that the closing of the motor-control oil switch for any sixty-cycle motor will open the oil switch of the twenty-five-cycle motor on the same pump, and vice versa. A separate control equipment will be provided for each pump motor, consisting of a motor-control oil switch for the primary circuit, a secondary resistance-controlling device and a secondary resistance. All pump controls will be of the non-reversible type and designed to start the motors by gradually removing the resistance in the motor secondary circuit. Secondary resistance controls will be of the time-acceleration, remote-control type, motor-operated. Secondary resistance controls will be arranged to close the operating circuit to pump discharge valve controls, and thus cause the automatic opening of the discharge valves when the pump motors have reached a specified speed. The shutting down of any pump will cause its discharge valve to close automatically. Separate control boards will be provided for the sixty-cycle and twenty-five-cycle systems. The suction and discharge valves will be motor-operated, with remote-control and limit-switch equipment, and the pump discharge valves are to be controllable from either switchboard. Mr. L. K. Rourke is commissioner of public works.

Automatic Starting of Exciter Turbine

At the generating station of the Salem (Mass.) Electric Lighting Company a 75-hp exciter turbine of the Curtis type is equipped with the apparatus shown in



DEVICE FOR AUTOMATICALLY STARTING EXCITER TURBINE ON FAILURE OF EXCITATION ENERGY

the accompanying photograph to bring it into operation automatically in case the bus voltage fails. Ordinarily the station excitation service is motor-operated, but in case the alternating-current bus voltage drops materially the plungers in a pair of solenoids normally bridged across a secondary circuit derived from the 2300-volt buses are released, closing a contact and energizing a pair of trip coils mounted on a panel on the turbine steam supply pipe. The closing of the trip-coil circuit releases the 5-lb. weight shown and opens a governor valve at the right of the turbine stop valve, a dash-pot under the weight spindle regulating the rate of the valve's opening and protecting the turbine from an immediate application of the full steam supply. The

turbine is brought up to its full speed of 3300 r.p.m in eighteen seconds. Resetting of the trip and valve mechanism is done by hand. The arrangement was devised by Mr. A. Michaud, of the Salem company.

Boiler Tests with Illinois Coal

A paper of considerable interest was read by Mr. Bryant Bannister, of Kewanee, Ill., before the Chicago Section of the American Society of Mechanical Engineers recently. It related to tests made about three months ago at the new and carefully designed boiler plant in the Kewanee works of the National Tube Company. The complete boiler equipment consists of four Edge Moor water-tube four-pass boilers, each having 6132 sq. ft. of water-heating surface and 1200 sq. ft. of superheating surface, Foster superheaters being installed. Firing is done by a seven-retort Taylor stoker equipped with air-extension grate. Each stoker has its own fan and engine. Low-grade Illinois coal in the form of 1.25-in. screenings is burned in this plant with very high efficiency, and this fact makes the report of the tests of considerable importance. Comment was made in the paper on the fact that the tests compare well with those of the large boiler units of the Detroit Edison Company. The data and results of the evaporative tests (which were made by the National Tube Company) are as follows:

Date	Oct. 27 to Oct. 30, 1913, inclusive
Duration	72 hours
Kind of furnace	Taylor stoker
Grate surface	91 sq. ft.
Water-heating surface	6132 sq. ft.
Superheating surface	1200 sq. ft.
Kind and size of coal	Illinois bituminous screenings
AVERAGE PRESSURES AND TEMPERATURES	
Steam pressure by gage	117.6 lb.
Temperature of feed water entering boiler	194.9 deg.
Temperature of escaping gases leaving boiler	412 deg.
Draft in furnace	0.011 in.
Blast pressure under grate	1.95 in.
Degrees of superheat of steam	77.9 deg.
TOTAL QUANTITIES	
Weight of coal as fired	222,703 lb.
Percentage of moisture in coal	16.15
Total weight of dry coal consumed	186,736 lb.
Total ash and refuse	39,185 lb.
Percentage of ash and refuse in dry coal	20.98
Total weight of water fed to boiler	1,563,910
Total weight of water evaporated, corrected for moisture in steam	1,563,910 lb.
Total equivalent evaporation from and at 212 deg	1,727,964 lb.
HOURLY QUANTITIES AND RATES	
Dry coal consumed per hour	2594 lb.
Dry coal consumed per square foot of grate surface per hour	28.5 lb.
Water evaporated per hour	21,721 lb.
Equivalent evaporation per hour from and at 212 deg	24,000 lb.
Equivalent evaporation per hour from and at 212 deg. per square foot of water-heating surface	3.28 lb.
CAPACITY	
Evaporation per hour from and at 212 deg	24,000 lb.
Boiler horse-power developed	695.6
Rated capacity in evaporation from and at 212 deg	21,155 lb.
Rated boiler horse-power	613.2
Percentage of rated capacity developed	113.4
ECONOMY RESULTS	
Water fed per pound of coal fired	7.022 lb.
Water evaporated per pound of dry coal	8.375 lb.
Equivalent evaporation per pound of dry coal	9.254 lb.
Equivalent evaporation per pound of combustible burned	11.711 lb.
EFFICIENCY	
Calorific value of 1 lb. of dry coal	11,094 lb. Fahr. heat units
Calorific value of 1 lb. of combustible	13,773 lb. Fahr. heat units
Efficiency of boiler, furnace and grate	80.95 per cent

The attendance at the meeting was about 150, and much interest was manifested in the paper. Mr. Paul P. Bird, chairman of the section, presided, and the discussion was opened by Prof. G. A. Goodenough, of the University of Illinois. Mr. Joseph Harrington, consulting engineer, presented a carefully considered written discussion, with drawings, one of which showed the relative sizes of the combustion chambers of the Detroit and Kewanee plants. Others taking part in the discussion, besides the chairman and the author, were Messrs. H. B. Brydon, H. M. Byllesby & Company; Robert H. Kuss, Edge Moor Iron Company; Thomas A. Marsh, Green Engineering Company; A. Bement, consulting engineer; F. G. Gasche, Illinois Steel Company, and J. C. Bannister, National Tube Company.

Use of Diesel Sets at Isolated Generating Points in Central-Station System

With the extension of its transmission system from a central power plant, a large public-service company operating in the Southwest recently transferred a couple of Diesel-engine units to a new point of isolated generation. In commenting on the transfer, the general superintendent of the company says that the operating experience with these 225-hp Diesel units has been very satisfactory, and he expresses the belief that for small-plant operation they make a very desirable form of generating set. Maintenance charges are found to be very low and there seems no reason, he adds, why with proper supervision they should be otherwise. The greatest difficulty experienced has been in obtaining competent operators. Since being moved to their new location, the transferred Diesel units are again in active continuous service, while their former load is now being handled by energy transmitted from a central power house. Later the transmission lines will probably be extended to the community where the engines are now in service, at which time the displaced engines will then be again transferred to some new isolated power-plant site.

Efficiency of Rectifier Set

What is the ratio of the energy consumptions in the two cases which follow: A 25-amp motion-picture arc lamp operating on a 110-volt direct-current system, and the same lamp fed from a mercury-arc rectifier operating on a sixty-cycle circuit? F. L. W.

The energy consumed in the second case will be larger than in the first, as there will be a loss in the rectifier tube and in the reactance coils used with it. A rectifier tube delivering 110 volts has an efficiency of about 86 per cent, figured on an 18-volt drop in the tube. The loss in the reactance coils with the tube can be reduced to the extent that the customer is willing to pay for the copper and iron used in its construction. About 12 per cent more energy would therefore be required to operate the lamp from a rectifier set than would be necessary were 110-volt direct-current service available.

Connection of Exciter, Rheostat and Field Circuit

Is it correct to connect the field rheostat, exciter and field winding of a single-phase generator in series when only one rheostat is used to regulate the voltage of the alternator? O. F. D.

If the exciter furnishes energy to only one single-phase generator field and only one rheostat is employed for voltage regulation, it should be connected in the exciter-field circuit. Most exciting units are compound-wound, and to connect a single rheostat in a circuit as you mention would introduce complications which would be unwarranted by the results obtained. Moreover, the energy loss in resistance would be more than if connected in the exciter circuit as has been described. However, if the exciter delivers energy to more than one generator field it will be necessary to use additional rheostats in each field circuit.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Polyphase Induction Motor.—H. KAFKA.—A mathematical article in which the author gives analytical formulas for the components of the primary current, the secondary current and the magnetization current as functions of the slip for the polyphase induction motor (general alternating-current transformer) and notes on the method of plotting circular diagrams.—*Elek. u. Masch.* (Vienna), Jan. 31, 1914.

Transformer Oil.—W. BRAUEN.—The author discusses the requirements of good transformer oil and the nature of the decomposition products of mineral oil and vegetable oil. The decomposition phenomena are due to oxidation. The behavior of mineral oils and vegetable oils in transformers and their relative advantages and disadvantages are described. The author concludes that for transformer use vegetable oil has advantages over mineral oil.—*Elek. Zeit.*, Feb. 5, 1914.

Lamps and Lighting

Electrodes for Arc Lamps.—MOLLENKOPF.—An abstract of a paper read before the Württemberg Electric Society. The author discussed the fundamental difference between the arc of a pure-carbon direct-current lamp and the arc of a flame-arc lamp, 90 per cent of all the light coming from the arc in the latter case. He then described the method of making lamp carbons. The raw material for carbons of first quality is exclusively lampblack and carbon powder obtained by grinding pure carbon scrap. For carbons of inferior quality petroleum coke is partly used. Natural coal is unsuitable as a raw material. The methods of grinding, mixing and pressing are briefly described. As to cored carbons, it is stated that for pure carbons the core is a mixture of water-glass and fine carbon powder. Its purpose is to produce a vapor of high conductivity so as to force the arc to a certain point and to prevent its wandering away. In flame-arc carbons the core consists of mineral salts (especially fluorspar for yellow light and cerium and lanthanum for white light). For baking the carbons are collected in bundles and subjected for eight days to a temperature increasing slowly to 1500 deg. C. The baking must be carried out very carefully and the temperature increased and later on decreased very uniformly.—*Elek. Zeit.*, Jan. 29, 1914.

Temperature Distribution in an Incandescent-Lamp Filament.—A. G. WORTHING.—An abstract of an American Physical Society paper. The author gives the mathematical theory and applies it to a tungsten filament. In any single filament the temperature variation from the axial temperature across any right section varies quite closely with the square of the radial distance. In different-sized filaments of the same material operated under the same conditions at the same maximum temperature, the temperature differences between the axes and the surfaces in the neighborhood of that maximum temperature vary quite closely in proportion to the radii.—*Phys. Review*, January, 1914.

Railroad-Station Lighting.—H. VON GLINSKI.—An article describing an analytical method for calculating the most economical arrangement of lighting a railroad station or any other installation in which the lamps are placed in a row and the illumination in the direction of this row is of importance. The calculations are made for the direct-current Dia flame-arc lamp, for the direct-current Excello flame-arc lamp, for metallic-filament lamps, and for the new nitrogen-filled tungsten lamp.—*Elek. Zeit.*, Jan. 29, 1914.

Generation, Transmission and Distribution

Electricity Supply of Large Cities.—KLINGENBERG.—The continuation and conclusion of his long paper on the electricity supply of large cities, with statistical data on the conditions in Berlin, Chicago and London.—*Elek. Zeit.*, Feb. 5, 1914.

Cranes.—ERNST SCHWARZ.—An article, illustrated by diagrams, on a method for calculating the regulating resistances used in the lowering operation of cranes equipped with the electric-brake system.—*Elek. Zeit.*, Jan. 29, 1914.

Traction

Mountain Railway.—The first part of a description of the locomotives and electrical equipment of the new single-phase Lötschberg railway, which commenced operation in July, 1913.—London *Electrician*, Feb. 6, 1914.

Automatic Signals.—G. KEMMANN.—In Germany the use of a signal system actuated automatically by the trains was for a long time restricted to the Barmen-Elberfeld suspended railway. The present author has introduced it on the Berlin rapid transit roads. In the article the author begins an account of the extended preliminary studies on automatic signal systems which were made for this purpose. The article is to be continued.—*Elek. Zeit.*, Feb. 5, 1914.

Installations, Systems and Appliances

Rates Dependent on the Power-Factor.—R. ARNO.—An article giving a summary of various papers presented at the International Congress at Turin. An account is given of the system devised by the author by which the power-factor of the load is taken into account in making up the charge for electricity supply. The load measured in this system consists of two-thirds of the true power plus one-third of the apparent power. In other words, the "complex load" is represented by the sum of two-thirds of the watts and one-third of the volt-amperes. To employ this schedule meters of the usual type are used with slight modifications. The author first takes up the case of a motor load and shows in this case that the complex load can be measured with sufficient exactness by means of either an ordinary electrodynamic or induction meter, the only condition being that the phase displacement of the shunt-coil flux, with respect to the potential difference at the ends of the shunt-coil circuit, is suitably modified. In three-phase plants which are not loaded symmetrically the complex load can be measured with sufficient exactness by two ordinary meters of the electrodynamic or induction type, the only conditions being (1) that while the phase displacement remains unchanged in one of the instruments it can be modified in the other and can be varied from 0 deg. to 30 deg in the case of the electrodynamic instruments or reduced from 90 deg. to 60 deg. in the induction instruments; (2) that the instruments would be inserted in a three-phase system as in the ordinary two-meter method, but with a lagging phase

difference of 30 deg. in the case of the induction instruments. The author then takes up the case of a lighting installation and shows that the "complex load" is there also of particular importance since lighting installations now often include step-down transformers, arc lamps, fans and motors for household use, resulting in decreasing the power-factor. The measurement of energy supplied by alternating current becomes similar to measurements of energy supplied by continuous current. The new measuring instruments are still effecively wattmeters and supply meters, and they present only the characteristic difference that the watts measured depend on cos θ, account being taken of the power-factor automatically. Ordinary alternating-current meters can be easily altered with small expense so as to be applicable to this new system of tariffs. In the case of electrodynamic instruments, it is sufficient to add a coil which may be easily made and constructed. In the case of induction-type instruments the method can be applied by making simple alterations to existing parts, and such modifications do not cause any increase in the loss in the instruments.—London *Electrician*, Feb. 6, 1914.

Protection of Wiring Installations.—A report of the committee of the German Association of Electrical Engineers on the protection of wiring installations by means of grounding, etc. The conclusion is reached that by means of good and correctly dimensioned ground connections protection can be obtained against high voltages to earth, but only in an indirect way in so far as the good ground connection causes the disconnection of the part of the installation where a fault develops. The same effect may be obtained in a simpler and safer way by connecting the switches, iron poles, stators, and all other parts to be protected, with the neutral wire. In this case the earth connection is necessary only in the transformer stations. The connection with the neutral wire at the same time prevents the occurrence of grounds at two different phases, which would result in the voltage of one of the outer wires rising above 250 volts measured to earth. The method of connection of the neutral conductor is, of course, effective as a protection only if properly carried out and if the dimensions are properly chosen.—*Elek. Zeit.*, Jan. 29, 1914.

Electrophysics and Magnetism

Electrification of the Atmosphere.—A note on a Kelvin lecture by Sir Oliver Lodge. The author indicated at some length the ways in which the probable weather can be predicted from the electrical conditions of the atmosphere. Thus, in fine weather, the earth is negatively charged, while the higher layers of the atmosphere are positively charged. These conditions vary in their intensity and in cloudy and rainy weather may even be reversed, so that phenomena of this kind give rise to the hope that a control of the electrical conditions of the atmosphere may be the proper line of research to follow in any attempt to control the weather. At any rate, as Sir Oliver pointed out, further investigation of the upper atmosphere is necessary to determine these points, and large-scale experiments ought to be carried out on the effect of discharging electricity from kites. Toward the end of the lecture Sir Oliver gave some interesting figures on the effect of high-tension current on the growth of crops, which had been obtained on an experimental farm in Worcestershire. This electrification appears to act as a supplement to the ordinary electrification of the atmosphere, and its botanical effect is now being studied at Leeds.—London *Electrician*, Jan. 30, 1914.

Some Electromagnetic Phenomena Relating to the Hall Effect.—E. P. Adams.—Corbino has discovered the following three electromagnetic effects: (1) If a metallic circular disk in which a uniform radial electric current flows is placed in a magnetic field at right angles to its plane, there results a circular current in the plane of the disk such that the current density is inversely proportional to the radius. (2) If the disk with the radial current flowing in it is suspended in a magnetic field so that its normal is inclined to the lines of force, a torque is produced tending to turn the disk. (3) If a radial current is induced in the disk on exciting a magnetic field at right angles to its plane, an equal and opposite radial current will be induced when the field is destroyed. The present author offers a theory to explain these effects in terms of the electrons and their characteristics.—*Phil. Mag.*, February, 1914.

Gamma Rays from Uranium Products.—H. Richardson.—An experimental investigation in which it is shown that uranium X (by which are denoted the products uranium X_1 and uranium X_2 in equilibrium) emits three types of gamma rays having absorbing coefficients in aluminum $\mu = 24$, $\mu = 0.70$, and $\mu = 0.140\,(cm)^{-1}$. Evidence is given that the first two types are probably emitted by uranium X_1 while the third penetrating type is due to uranium X_2. The results obtained support also the view that the atomic weight of actinium is about 230 and that actinium is probably a branch product from uranium X_1.—*Philos. Mag.*, February, 1914.

Theory of X-Ray Reflection.—C. G. Darwin.—The author discusses the structure of the lines photographed by Moseley in his method of finding the X-ray spectra of the elements. Proceeding on a theory exactly analogous to that of light, the intensity of reflection is found both for monochromatic and for heterogeneous radiation. The existence of a refractive index for both crystalline and amorphous substances is indicated by the theory. The correction for the temperature vibrations is calculated. The effect of the several electrons in an atom is calculated and is seen to account for the phenomenon of "excess radiation" observed in the scattering of X-rays by amorphous substances. The results are compared with the experimental results of Moseley and Darwin on rock salt.—*Philos. Mag.*, February, 1914.

Electrochemistry and Batteries

Ozone.—P. Postel-Vinay.—An illustrated article on the use of the Otto ozonizer for water sterilization in Paris. The construction of this ozonizer is shown in

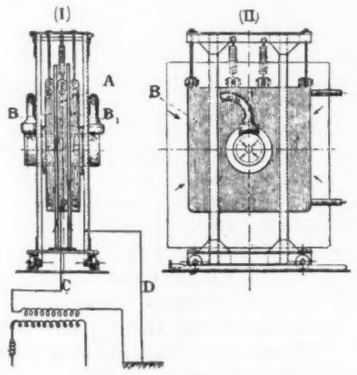


FIG. 1—OZONIZER

Fig. 1. The current from the high-tension transformer is carried directly through the conductor *C* to the high-voltage electrode *A*. This is placed between the two low-tension electrodes *B* and B_1, which are connected to earth through the conductor *D*. The electrodes are cooled by means of water circulation. Between the electrodes dielectrics are placed. At Paris water taken from the Marne River is first carried through some

filters and then enters the ozonizer. Electrical energy is supplied in the form of three-phase currents at 220 volts with a frequency of fifty cycles. Three motor-generators transform this energy into single-phase current at 500 cycles. This frequency is particularly advantageous to raise the efficiency of ozone production. Under normal conditions 20 kw produces about 3 kg of ozone per hour with an average concentration of 10

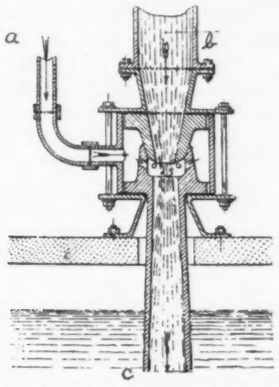


FIG. 2—MIXING OZONE WITH WATER

milligrams of ozone per liter of air. The total capacity of the plant is sufficient for the sterilization of 120,000 cu. m of water per day. Fig. 2 shows a method of treating the water with the ozone. The water passes downward through *b* while the ozonized air enters through *a*. The sterilized water leaves at *c*. Statistical data are given on the bacteriological and sanitary results obtained with ozone treatment of water.— *La Revue Elec.*, Jan. 16, 1914.

Units, Measurements and Instruments

Thermopile.—W. W. COBLENTZ.—An abstract of an American Physical Society paper on a thermopile of bismuth and a bismuth-tin alloy. The efficiency of these thermopiles is such that 1 microwatt of radiant energy produces a rise in temperature of 15 to 16×10^{-6} degrees in the receiver. The emf developed depends upon the number of junctions attached to the receiver and their manner of connection. This type of thermopile may be used in photometric and other investigations with rather insensitive auxiliary apparatus.—*Phys. Review*, January, 1914.

String Galvanometer.—RUDOLF FORESTER.—The author analyzes the motion of the string galvanometer with and without air damping and measures its sensitiveness as a function of the frequency under the influence of a sinusoidal alternating current. The theory is compared with the results of practice.—*Elek. Zeit.*, Feb. 5, 1914.

Selenium.—P. J. NICHOLSON.—An article on the physical properties of selenium. The ultra-violet absorption of metallic selenium was roughly determined. Sensibility curves were obtained and a mathematical deduction is given with the electron theory as a basis, from which the most important facts known regarding the behavior of selenium cells are deduced.—*Phys. Review*, January, 1914.

Testing Materials.—An extract of the annual report for 1912 of the German Bureau for Testing Materials at Berlin-Lichterfelde. There are five departments relating to the testing of metals, testing of structural materials, paper and textile tests, metallography and general chemistry respectively.—*Elek. Zeit.*, Jan. 29, 1914.

Unipivot Instruments.—An illustrated article on unipivot instruments for alternating-current and direct-current circuits made by a British firm. The action of raising the instrument from the table automatically causes the coil to be lifted from its bearing. One type of instrument, called the cross-point instrument, is employed for determining the ratio of two varying electrical quantities, such as resistance, current or pressure, and can also be used in conjunction with a vacuum-junction or a barretter for the measurement of impedance, attenuation in telephone lines, etc. The instrument contains two of the large-size unipivot systems, both coils being mounted in the same magnetic circuit. This arrangement insures that any variation in the magnetic flux will affect both coils equally and will, therefore, not alter the ratio of the indications. The pointers are at slightly different levels, so that they may cross each other. Each pointer is provided with its own calibrated scale, which subtends an angle of 60 deg., and each instrument may be used independently for ordinary measurements. For measurements of ratios the point of intersection of the pointers is read off on a chart drawn between the two scale arcs, and this chart may be marked so as to give directly the ratio of the two quantities under test. This arrangement is also applicable for the simultaneous measurement of three factors, such as pressure, current and resistance. For example, one scale may be marked in millivolts, the other in microamperes, milliamperes or amperes, and the chart in resistance. Instruments for high-frequency measurements are also described—London *Electrician*, Feb. 6, 1914.

Crystal Rectification.—A. E. FLOWERS.—An article on the characteristics of crystal rectification especially at very low and very high frequencies. The rectification at high frequencies tends to be greater than at low frequencies with large currents, although but very little different for small currents. For very small currents the rectification tends to disappear, particularly for large contact areas and low current densities. The rectification ratio for small currents is nearly proportional to the square of the rectified current and nearly proportional to the first power of the total or root-mean-square current. Even very large contact areas will rectify well with large currents. The rectification ratio for very small currents may be improved by the use of very small contact points, but a much larger potential is required to get the same amount of current. The current density must be equal to or greater than a given minimum value for good rectification. Resistance in series with the galena-crystal rectifier greatly decreases the rectification ratio even for the same potential difference on the terminals of the rectifier.—*Phys. Review*, January, 1914.

Telegraphy, Telephony and Signals

Mechanical Analogy of Loaded or Unloaded Telephone Cables.—J. A. FLEMING.—An abstract of a paper read before the British Physical Society on an experimental method for the production of vibrations in strings, illustrating the properties of loaded and unloaded telephone cables.—London *Electrician*, Feb. 6, 1914.

Telephone Exchanges.—J. BAUMANN.—An illustrated article on new improvements in traffic distribution for telephone exchanges. The author discusses the importance of distributing the traffic in an exchange and gives details of his modified system for attaining this end.—London *Electrician*, Jan. 30, 1914.

High-Frequency Alternating Currents in Telegraphy etc.—A. MAIOR.—A mathematical article on the use of high-frequency alternating currents in telegraphy, telephony and for power transmission. The author discusses a number of fundamental formulas connected with the propagation of high-frequency currents such as are used in telegraphy, telephony, and for power transmission. Various arrangements which have been

tried for double telephony are given with certain experimental results.—London *Electrician*, Feb. 6, 1914.

Mercury-Vapor Telephone Relay.—A note on a recent British patent (No. 29,384, 1912) of H. De Forest Arnold and the Western Electric Company of this country. This invention comprises an arrangement of apparatus, including an ionized stream, such as that in a mercury-vapor arc, which is deflected under the influence of a magnetic field. There is a circuit in which the current variations in the incoming circuit are reproduced in circuits independent of the ionized stream. A non-arcing gap in the outgoing circuit is arranged transversely across the ionized stream and parallel to the magnet field produced by an electromagnet placed as near as possible to the longitudinal center of the ionized stream. The outgoing circuit is composed of a balanced differential circuit connected to electrodes of special design and arrangement.—London *Elec. Eng'ing*, Jan. 22, 1914.

Laying Telephone Cables.—A. PODMORE.—An illustrated article on the laying of telephone cables across the Golden Horn at Constantinople, Turkey.—London *Electrician*, Jan. 30, 1914.

Miscellaneous

Electrical Engineering and Industry.—C. P. STEINMETZ.—A Franklin Institute lecture on the effect of electrical engineering on modern industry. Electrical energy is the only form which is economically suited for general energy transmission and distribution. Civilization depends on the supply of materials and of energy as its two necessities. The supply of materials is taken care of by the transportation systems of the world. The supply of energy is being developed by electrical systems of transmission, which with regard to energy become what the railway system is with regard to materials. Introduction of electric energy in place of other forms of power rarely can be a mere substitution, but usually requires a change of the methods of power application, a reorganization of the industry to secure maximum economy.—*Journal Franklin Inst.*, February, 1914.

Book Reviews

GAS AND FUEL ANALYSIS. By Alfred H. White. New York: McGraw-Hill Book Company, Inc. 276 pages, illus. Price, $2.

As might be expected from the wide experience of the author, this little book is very comprehensive and well worth while. The clearness with which the various operations considered are described should render the work of value not only to the student of chemistry but particularly so to the engineer. An admirable feature is the stress laid on errors that may arise from improper methods of sampling, together with a discussion of the sources and limits of errors in analytical and calorimetric operations. The volume is brought up to date by the inclusion of the (1913) report of the joint committee of the American Chemical Society and the Society for Testing Materials on methods of analysis and determination of calorimetric value of fuels.

WIRELESS TELEGRAPHY. By C. L. Fortescue. 1913. New York: G. P. Putnam's Sons. 143 pages, illus. Price, 40 cents.

This little book is intended for readers who already have some knowledge of applied science and who wish to extend their acquaintance to include the practice and principles of radio-telegraphy. The author shows himself to be familiar with current radio engineering and by clear explanations and analogues presents his points logically and forcibly. Through the first four chapters the book treats electrical quantities and phenomena concerned in radio transmission, and in the next two chapters the connection between the abstract principles and the actual apparatus is brought out. Six of the remaining seven chapters contain descriptions of modern applications of radio apparatus, including airship and aeroplane installations, and the text of the book is concluded by a chapter on "History," which is more nearly accurate than is common in publications on wireless telegraphy. A partial bibliography of the art is given as an appendix. While the author does not attempt to treat the subject in detail and has omitted or failed to emphasize some matters of interest, he has produced a very readable book which meets its purpose excellently. It is regrettable that he has fallen into the error of describing a traveling electromagnetic wave as having alternate rather than simultaneous maxima of electrostatic and electromagnetic forces. This may easily be righted in future editions.

TRANSFORMER PRACTICE. By William T. Taylor. New York: McGraw-Hill Book Company, Inc. 278 pages, illus. Price, $2.50.

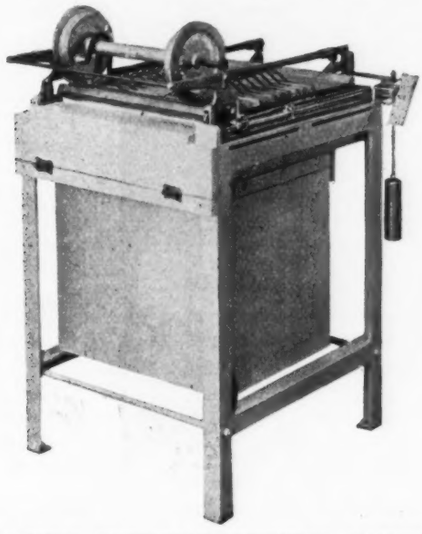
In its earlier edition this book was published under the title "Stationary Transformers." It has been entirely rewritten, and the second edition, which appears under the new title, contains many valuable additions. No attempt is made to treat of the fundamental principles underlying the action of static transformers or to enter deeply into details of design, the book being intended mainly for the use of operators and those engineers who may have to handle, install and connect transformers, possibly in out-of-the-way places where a man is compelled to rely on his own knowledge and experience or on such written information as he may have at hand. The various possible ways of connecting up groups of transformers for two-phase and three-phase work are fully discussed. The explanations are made in simple language without unnecessary verbiage, and the numerous excellent diagrams, showing both the actual connections and the vectors of the alternating quantities, add greatly to the value of this, perhaps the most important, section of the book. Almost every conceivable method of transforming two-phase to three-phase, and vice versa, is clearly explained, and a complete chapter is devoted to six-phase transformation and operation. Other matters dealt with include methods of cooling transformers, the installation and setting to work of large power transformers, drying out, testing and treating the insulating oil, connections of auto-transformers, and the operation of series transformers as used with current-measuring instruments. In Chapter XIII, which treats of feeder potential regulators and of compensators, the induction type of regulator receives its due share of attention, and its action is clearly explained; but a drawing showing a section through one of these regulators would have been helpful to the reader. Chapter XIV treats of the practical testing of transformers, while Chapter XV—the last—contains several examples of transformer specifications. Without doubt, the book is almost invaluable to the man for whom it has been written, for he can find herein collected together much useful and necessary information that he will frequently be in need of and which otherwise must be sought in multitudinous notebooks and back numbers of technical journals. Reliable information on the subject of temporary transformer connections, which one may want only occasionally in emergencies, but which he then requires urgently and in a usable form, is here given, along with the many other notes of interest which the author has gathered together during the course of his wide experience in various quarters of the globe.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Photographic Printing Machine

The printing machine shown in the accompanying illustration is being put on the market by the Stadler Photographic Company, 1322 Wabash Avenue, Chicago, Ill. The sensitized paper is held down by a flexible roller cushion, the rolling action of which has a tendency to remove any wrinkles or kinks in the paper. The distribution of pressure is very even and is obtained through two cross-bars which press down on springs, each spring in turn pushing down a small wooden bar which is fastened on the back of the roller cushion. Five 250-watt tungsten lamps provide the light. These lamps are switched on and off with an ordinary knife switch. The timing device is built on the



ELECTRIC PHOTOGRAPH-PRINTING MACHINE

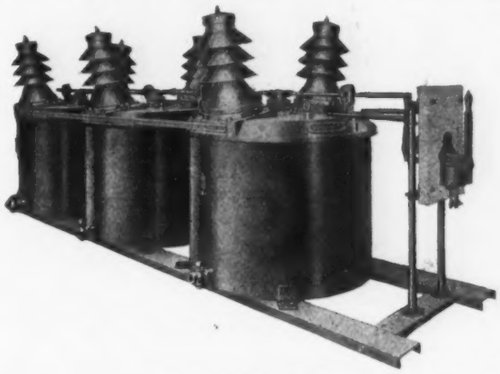
gravity principle, and a fan and a weight are used to regulate the time of exposure. As soon as the proper length of time has elapsed to expose the paper, the cushion is released and at the same time the supply of energy is cut off; the cushion is then forced back by means of springs incased in aluminum casings.

High-Voltage Switch

The Condit Electrical Manufacturing Company, Boston, Mass., has developed a high-tension switch for pressures up to and including 70,000 volts. The breaker can be furnished for either hand or electrical operation.

The switch illustrated herewith is of the 200-amp, 70,000-volt, three-pole, single-throw, hand-operated type, each pole being a separate and distinct unit. The multiple-pole breaker consists of two or more units connected together by the operating or pull rods, which work the contacts and tripping mechanism. Each unit consists of a tank of heavy welded boiler-iron and is provided with an iron cover securely bolted to a flange on the upper edge of the tank, upon which is mounted the operating mechanism. This arrangement makes possible a mounting for multipole operation with any desired spacing. Use has been made of cylindrical instead of oval tanks to insure maximum mechanical strength.

The switches are filled with insulating oil, the height



HIGH-TENSION SWITCH

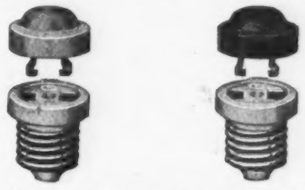
of which may be determined by sight gages. The break of the switch takes place near the bottom of the tank under the greatest available pressure of oil. Provision has been made in each tank to take care of any gases arising from arcing.

The moving contacts consist of laminated brushes and are carried by heavy metallic cross-bars. The stationary terminals are protected by means of porcelain petticoat insulators which are securely fastened to the covers. The operating mechanism consists of a toggle arrangement and is so proportioned that the maximum closing effort is obtained with the minimum force on the handle.

Operation of the circuit-breaker is effected by the movement of a handle mounted either near the breaker or at some remote point and moving horizontally.

Attachment Plugs

Plugs that can be easily wired are shown in the accompanying illustrations. One is equipped with a porcelain cap and the other with a composition cap. The



FIGS. 1 AND 2—ATTACHMENT PLUGS WITH PORCELAIN AND COMPOSITION CAPS

contacts "go home" in the base at any angle. The rounded part of the contact forces its way into the clip and holds it firmly. These attachment plugs are the product of the Trumbull Electric Manufacturing Company, Plainville, Conn.

Light-Weight Test Meter

An alternating-current test meter recently placed on the market by the General Electric Company, Schenectady, N. Y., has been designed to lighten the burden of the test man. The device weighs only 7.75 lb. and has outside dimensions less than 6 in. square and 7.5 in.

FIG. 1—TEST METER COMPLETE

high when closed. The meter is contained in an antique-finished oak case and is provided with a leather strap for carrying.

The moving element consists of an aluminum disk mounted on a shaft of aluminum alloy. Attached to the shaft is a large hand which indicates on a large dial divided into 100 parts. Two smaller pointers with corresponding dials revolve on the large dial. One of these small pointers makes one revolution for every ten made

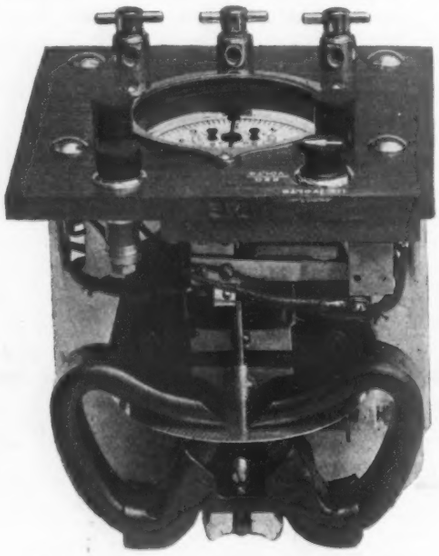


FIG. 2—METER REMOVED FROM CASE

by the large pointer, while the other makes one revolution for every 100 of the large one.

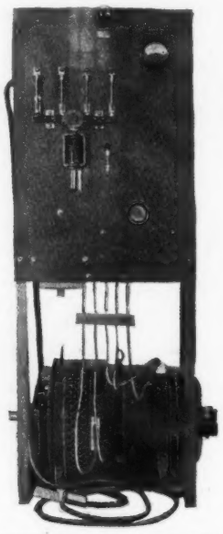
The current coils are of 1-amp and 10-amp capacity, making the meter suitable for testing meters of capacities up to 15 amp on both heavy and light loads. In series with the 1-amp winding there is a fuse of small current-carrying capacity which protects this winding from burning out through an accidental overload or short-circuit. The meter is provided with a micrometer for full-load and light-load adjustments.

By the use of this meter 90 per cent of the alternating-current meters of the average central station, including polyphase meters, it is declared, may be tested quickly, conveniently and accurately at the point of installation.

The test meter described is known as the IB-5 instrument and is shown complete in Fig. 1. Fig. 2 shows the meter removed from its case.

Rotary-Converter Set for Tapered-Rate Battery Charging

The accompanying illustration shows a moderate-priced rotary-converter battery-charging set especially adapted for use in a private garage where it is expected to receive little attention. The equipment is designed to charge at a high initial rate which gradually tapers off, before gassing of the batteries commences, to a final rate which may be maintained indefinitely



ROTARY-CONVERTER BATTERY-CHARGING SET

without overheating the cells. While the efficiency of this apparatus is 5 per cent to 7 per cent lower than that of a mercury-arc rectifier set, yet the actual cost of charging is lower, it is declared, because the depreciation and cost of repairs are negligible. The method of charging employed with this set, it is also claimed, will prolong the life of a battery from 25 per cent to 100 per cent over that obtained with a constant-potential charge.

The converter outfit is equipped with an automatic device which opens the charging circuit when the battery voltage reaches a predetermined value, independent of any variation in the voltage of the supply circuit. In case the circuit becomes grounded or overloaded, the charging switch will also open. If the alternating current supplied to the rotary converter is interrupted temporarily, an automatic device will start the charging operation again when the supply line is energized. The operation of the outfit is simple. After inserting the charging plug in the battery receptacle the main switch on the panel is closed. The charging will then continue until automatically shut off by one of the devices mentioned. It is simple to install the outfit, as only the alternating-current wires have to be connected.

Another feature of this apparatus is that energy from the battery may be pumped back into the alternating-current supply system through the rotary converter if it is desired to discharge the battery. No energy is therefore lost except that required to run the converter.

For use in public garages a double-voltage motor-generator is furnished to avoid the necessity of charging the batteries in series. This generator furnishes 75 volts and 115 volts, so that all batteries containing less than thirty cells may be charged on the lower voltage and those containing more cells are connected to the 115-volt charging plug. Both of these voltages may be varied at will, saving a considerable loss in resistances usually employed in charging.

The Lincoln Electric Company, Cleveland, Ohio, which manufactures these outfits, has furnished data which show the comparative cost of charging with one of its set and with a mercury-arc rectifier. Tests were made on 11-MV and 13-MV forty-cell lead batteries and A-4 sixty-cell Edison batteries, using 30-amp, 40-amp and 50-amp tubes respectively. The tube depreciations assessed per battery charge in each case were 45 cents, 55 cents and 65 cents respectively. These values were obtained by dividing the price of the tube plus the charge for installing a new one by the guaranteed life of the tube and multiplying by six the length of a normal charge. While the energy consumed by the rotary set was about 10 per cent more than that used by the rectifier in each case, the depreciation chargeable to the tubes brought the cost of rectifier charging above the rotary method. The range of percentage saving in each case is shown in the accompanying table.

SAVING DUE TO USE OF ROTARY-CONVERTER SET IN CHARGING BATTERIES

Cost of Energy	PERCENTAGE SAVED IN CHARGING		
	11-MV Forty-Cell	13-MV Forty-Cell	A-4 Sixty-Cell, Edison
2 cents per kw-hr.	56.0	53.7	52.2
15 cents per kw-hr.	8.2	7.1	6.2

Multi-Stage Turbines

The Kerr Turbine Company, Wellsville, N. Y., is now manufacturing turbines of the multi-pressure type rated at from 700 hp to 1800 hp. Turbines of smaller capacities and rated up to 700 hp were developed before the design of the larger sizes was attempted.

Fig. 1 shows an "Economy" turbine with a horizontally split casing and pedestal bearings. It also illustrates how the rotor may be inspected or removed entirely without breaking the steam connections. In Fig. 2 is shown a typical section of machines rated at from 500 kw to 750 kw. The diaphragms between the stage compartments are integral with the casing and are lifted off with the cover when the latter is removed; each wheel is, therefore, exposed down to the carbon packing on the shaft when this operation is performed. The guide vanes or steam nozzles are cast in the diaphragms.

Steam is expanded in a number of stages or steps, and the pressure drop at each set of nozzles is comparatively small. The velocity of the steam is not very great and is said to be rarely over 1000 ft. per minute. The leakage area from stage to stage is also small, being confined to the annular space where the shaft goes through the pressure chamber walls or diaphragms. Leakage from stage to stage at the shaft is prevented by floating carbon packing rings held in the diaphragms. In the high-pressure and low-pressure ends it is obviated by cover plates which are arranged so that they can move freely in any direction in case the turbine shaft should vibrate on account of

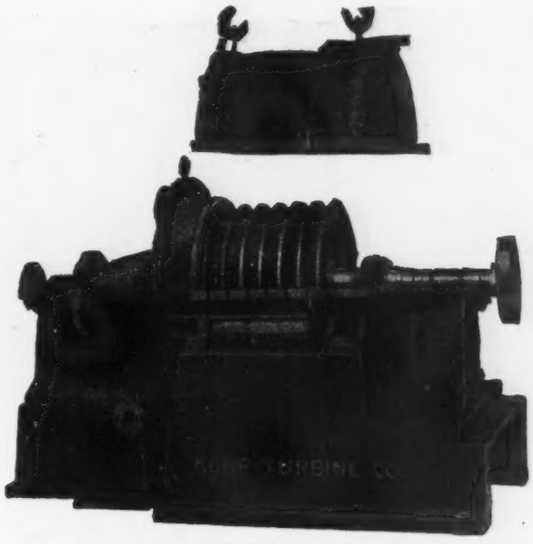


FIG. 1—STEAM TURBINE WITH COVER REMOVED

a large amount of water being present. Owing to the fact that the steam pressure is higher on one side of the diaphragm than on the other, the carbon rings are kept tight against the ground seats. The large clearance permissible at the buckets is utilized to protect the buckets from stripping, and the hard, tough original skin left on the drop-forged buckets easily resists the tendency toward erosion.

A small turbine-driven centrifugal pump with the impeller submerged in an oil reservoir forces oil to all the bearings before the machine is turned over. After starting, a spur-geared oil pump directly connected to the governor spindle forces oil under a pressure of 6 lb. per sq. in. to every bearing of the machine. The oil flows back to a large reservoir in the bed-plate, where it is strained and water-cooled. An independent emergency governor operating a quick-closing throttle valve is provided with each turbine. This governor is of the oil-relay throttling type, the valve being moved by oil under pressure of 30 lb. per sq. in.

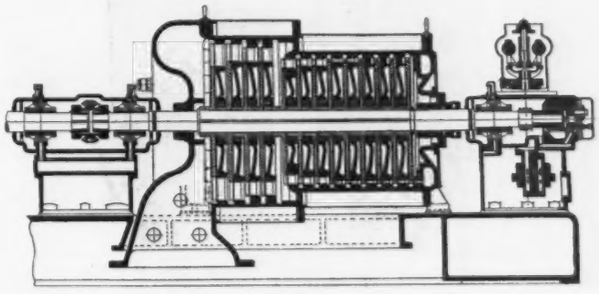
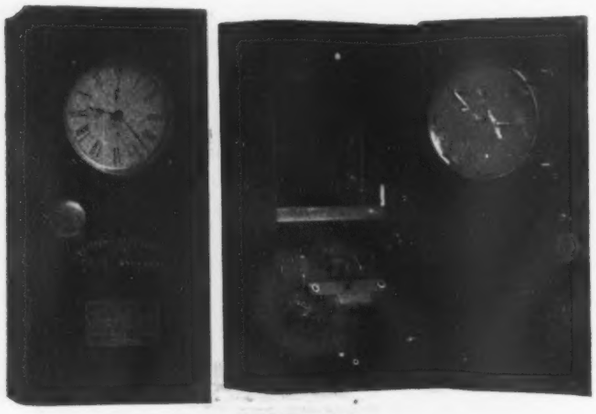


FIG. 2—SECTION OF TURBINE

Heavy pedestal bearings are used, and they are lubricated by means of oil rings. A marine-type thrust bearing which is adjustable and can be replaced maintains the rotor in its proper position. The entire unit is mounted on a heavy cast-iron bed-plate. The lagging outside the turbine cylinder is covered with enameled sheet iron.

Improvement in Alarm-Clock Time Switch

Improvements have recently been made in the alarm-clock time switch described in the Dec. 27, 1913, issue of the *Electrical World*, rendering it more nearly fireproof. As will be seen from the accompanying illustrations, the alarm clock has been placed inside a sheet-



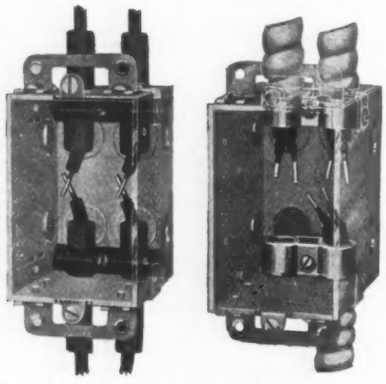
FIGS. 1 AND 2—TIME SWITCH ACTUATED BY ALARM CLOCK

metal case and the actuating spring is extended through the switch handle and bent so that it will lift the trip lever automatically when the switch is closed. Otherwise the design of the time switch has remained unchanged.

This device, which has been approved by the Underwriters' Laboratories, is being manufactured by Victor G. Jensen and will be marketed by the Kennedy-Webster Company, Rand-McNally Building, Chicago.

Loom and Cable Clamps

In Fig. 1 is shown a steel wall-box equipped with loom clamps and in Fig. 2 a similar box with cable clamps. Each clamp is provided with a ring or bushing which forms part of the clamp and protects the cable from abrasion. The bushings are heavily brass-plated to insure good electrical contact and to prevent corrosion.



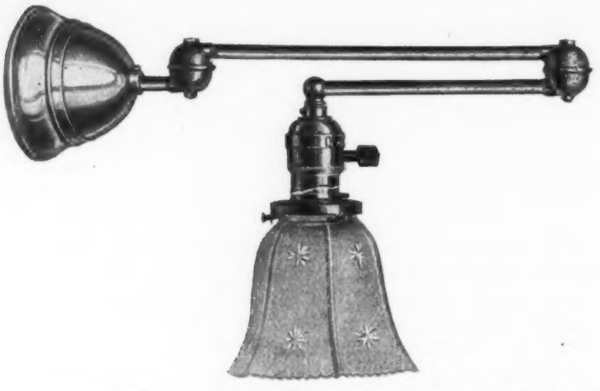
FIGS. 1 AND 2—BOXES FITTED WITH LOOM AND CABLE CLAMPS

The boxes are furnished complete, and a few turns of the clamp binding-screw are sufficient to fasten the cable firmly in place. One or two cables can be clamped to the box.

The Machen & Mayer Electrical Manufacturing Company, Philadelphia, Pa., is placing these clamps on the market.

Flexible Fixtures with Improved Swivel Joints

Wires passing through swivel joints in electric fixtures are usually continuous and are apt to be broken if the fixture is bent very often. To obviate this objection to jointed fixtures, the Ohio Lighting Fixture Company, Toledo, Ohio, is manufacturing adjustable fixtures, similar to the one illustrated herewith, which are equipped with improved swivel joints. The joint consists of two hemispherical shells held together by a bolt and nut. Inside the shells, with the bolt as an axis, are mounted two insulated disks and embedded in the adjacent faces of these are two rings which slide on each other. Passing through the cores of the two disks and surrounding the bolt but insulated from it are telescoping metal tubes. The conductors leading to the joint connect onto the telescoping tube and sliding ring on one disk, while the outgoing wires are connected similarly to the other disk. With this sliding-contact construction inside the joint, it is possible to rotate the members of the fixtures through any angle without injuring the wires. It is also simple to wire or repair these fixtures as there are no sharp turns



FLEXIBLE FIXTURE EQUIPPED WITH IMPROVED SWIVEL JOINTS

through which to thread the wire, and access to the interior of the joints may be readily had by removing the bolt and nut in the joint.

Improvements in End-Cell Switches

The Electric Storage Battery Company, Philadelphia, Pa., has recently developed an improved method of end-cell switch control for large central-station batteries. Switches are now being built for continuous use up to 10,000 amp and are capable of handling currents of more than 40,000 amp for a few minutes. The 5000-amp and 10,000-amp switches are made with two rows of switch points connected in parallel and two contact rails also connected in parallel, with four traveling brushes mounted on a common carriage, each brush being designed to carry one-fourth of the total load.

In this latest type of cell-switch control a combined control switch and indicator is provided on the switchboard which may be instantly set to indicate the point to which it is desired to adjust the cell switch, and the traveling brush on the switch will thereupon move to the point indicated and stop at that point without further attention from the operator. This combined indicator and control switch consists of a dial provided with a hand wheel at the center and an opening at the top through which an illuminated number is seen, which corresponds to the number of the cell connected to the

bus through the end-cell switch. By turning the hand wheel, any desired number may be brought opposite the opening in the dial. At the same time connections are made by means of a series of contacts on the back of the board controlled by the motion of the hand wheel whereby the cell-switch mechanism is set in motion, and the brush travels to the point indicated by the new number thus brought to view.

When the cell switch is at rest the number visible on the dial is illuminated by a white light appearing from behind the apparatus. As soon, however, as the cell switch is put into operation by a movement of the hand wheel to a new position, a colored lamp takes the place of the clear lamp, red being used for motion in the direction to increase the number of cells and green for motion in the opposite direction. This colored illumination (red or green as the case may be) is intermittent as the switch travels from point to point and consists of a series of flashes separated by dark intervals. As soon, however, as the cell switch comes to rest at the point indicated by the number on the dial the steady white illumination is restored. The information given to the operator by this indicator is therefore positive in character, and as long as he sees the flashes of colored light he knows that the brush is traveling in the desired

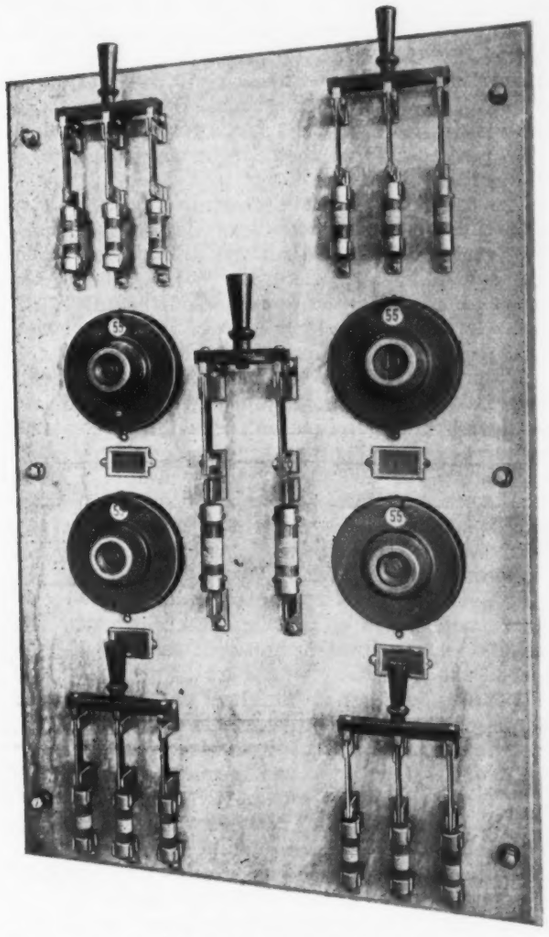


FIG. 1—CONTROL PANEL FOR FOUR END-CELL SWITCHES

direction. If the switch should accidentally stop at the wrong point, this fact is indicated by a steady colored light without the flashes. If there should be any interruption in the control circuits, the fact would be indicated by the entire disappearance of illumination, since the same conductors which serve to control the operation of the cell switch also transmit current for illuminating the indicator. Fig. 1 shows a complete control panel for four end-cell switches, while in Fig. 2 there are shown the details which characterize the end-cell switch apparatus.

This control system is said to be absolutely "foolproof." The operator may set the dial at any number and then immediately change his mind and reset it at

FIG. 2—DETAILS OF END-CELL SWITCH APPARATUS

another point without waiting for the cell switch to reach the point first indicated. In fact, he may change the setting as often and as rapidly as he may desire in either direction, and no harm whatever, it is declared, will result.

The cell-switch brush will finally arrive at the point indicated by the last setting.

Gate Valve for Repacking Under Pressure

The Walworth Manufacturing Company, Boston, Mass., is offering for sale a brass gate valve with nonrising stem and solid wedge, which will permit of repacking while under pressure without the customary discomfort to the operating engineer. This packing process is accomplished by opening the valve as far as possible and drawing the stem collar down onto a fiber gasket which makes a steam-tight joint allowing the stuffing box to be removed without the escape of steam. The stuffing box screws are located on the outside of the bonnet.

The metal in the valve is distributed in a manner which gives maximum strength and results in a design of pleasing appearance. The hexagonal ends are made heavy so that they will withstand the strains imposed in connecting the valve to the line. These valves are regularly manufactured in sizes ranging from 0.25 in. to 4 in. with either threaded or flanged ends. They can also be furnished in quick-opening types and may be threaded for hose attachment. The self-packing feature will doubtless be appreciated by engineers who have had to pack valves under pressure with steam blowing out of the stuffing box.

Jobber, Dealer and Contractor

Officers of Louisville Contractors' Association

New officers were chosen by the Louisville Electrical Contractors' Association at its recent annual meeting at the Henry Watterson Hotel, Louisville, Ky. Mr. C. C. Childers, of Childers & Waters, succeeded Mr. Frank Good, of F. A. Clegg & Company, as president; Mr. Herbert Ottenheimer, of the Home Electric Company, was made vice-president; Mr. Gus Albrecht, of the Albrecht Hardware Company, was elected secretary, and Mr. James Clark, of the James Clark, Jr., Electric Company, was made treasurer. Arrangements are being made by the contractors to have the Kentucky Actuarial Bureau, a fire-insurance rating organization, handle all of the association's electrical inspection work, instead of only a part of it, as at present.

Need of Guarantee in Electrical Contracting Work

Speaking before the recent meeting of the New Jersey Electrical Contractors' Association, Mr. A. H. Moses, an architect, voiced the necessity of some sort of guarantee on the work of electrical contractors. Since the work of the electrical contractor has assumed such importance, and since there is in many places an association of master electricians, it has been suggested that it would be wise for each association to have a committee of experts upon whom the architects could call for advice and who would state in an impartial way whether the electrical contractor had fulfilled honorably and fairly the terms of the contract or whether he had slighted the work. This committee, in the opinion of Mr. Moses, should be composed of men who would render a fair and just decision in the various cases that might come before them for their action. Then, in the event of the committee finding that the electrical contractor was doing "shoddy" work, he should be amenable to punishment in some way and, if severe treatment is necessary, possibly expelled from the contractors' association. When the architects and good builders find that the contractors' association stands only for straight, honorable and efficient work, and that a dishonest practitioner has no place in its ranks, then membership in such a contractors' association will be of great value to its members and to the public at large and will do much to build up the electrical contracting business as a responsible factor in construction work.

Varieties of Estimators

An electrical contractor speaking to a gathering of about 300 of his fellows divided contractors into four classes, based upon their abilities as estimators. The first class embraces the contractor that knows the cost of the work as well as the overhead charges incident to the business. The second class includes the contractors who have a general knowledge of the business but do not know what the cost of doing business is. The third class includes the fly-by-night concerns with financial backing. This class of contractor usually lasts about a year, since it takes about that length of time to complete the various jobs. The manager usually makes one job wash another. The time he remains in business also depends of course on how much money the financial backer can be made to put up. In one case as high as $50,000 was spent before the financial backer was convinced of the futility of expending any more money. The erratic bidder was put in the fourth class. A contractor of this type causes much trouble, since on some work his bids are very low and on others very high. The high bid is laughed at and thrown into the waste basket, and the low bid, if it receives any consideration at all, is sometimes used to sandbag the man who has put in a legitimate estimate for the work. The fourth type of contractor is, in the majority of cases, convinced that the successful bidder is going to lose money on the job, because he imagines the work was awarded at a figure less than his.

Separate Contracts for Electrical Work Essential

According to a prominent New Jersey architect, the practice of having a general contractor and sub-contractors for different parts of work is not conducive to the attainment of the architect's ideal. The reasons given for this conclusion are: (1) The general contractor, in order to secure the contract, will use the lowest estimate received from a sub-contractor, often without proper knowledge of the man and his ability to do the work, simply because he gave a low bid; (2) after a general contractor has secured a contract, instead of giving the work to the sub-contractor whose bid he used, he will often see various people in the same line of work and, by hook or crook, try to get their bid down and make an extra saving to himself thereby—not realizing that if the estimate of the sub-contractor were cut below a proper charge for his work, he could not afford to give as good service as when he is fairly and properly paid for it.

The work of the electrical contractor is of a special kind, because the application of electricity to buildings is of recent origin, and for the safety of the user certain rules and regulations have to be enforced. It is therefore necessary that the person installing the wiring should have some knowledge of the force with which he is dealing and of the variety and kind of appliances available and suitable for the work. Consequently, in electrical work, the money consideration should never be the only one. The reason for making a contract with a general contractor was the desire to have some one responsible for the whole work who should engage to see that each part was executed properly and who should be able to control the craftsman on the job and deliver up the completed work to the architect and owner for a certain stipulated sum. However, the public is gradually realizing that work can be had at very little if any more expense by placing the architect in full control and letting through him separate contracts for each part of the work.

It is obvious that an architect cannot master all the details of the electrical contractor's business any more than he can master all of the technical details of plumbing, painting, masonry and the numerous other trades involved in the completion of a modern building. His practice is therefore to consult with experts in every important branch so as to get in touch with the latest appliances, and to prepare contracts and specifications on which reliable estimates can be made. A carefully prepared set of plans and specifications wherein nothing is left to the imagination gives the owner what he wants at a reasonable cost and enables the contractor to figure on a profit. Inasmuch as the general contractor knows very little about electricity, why should he employ the electrician, and why should the owner pay a profit to two parties—that is, a profit to the electrical sub-contractor and another profit to the general contractor who is supposed to shoulder the responsibility?

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

High-Voltage Oil Switches Sold.—The Pacific Electric Manufacturing Company, of San Francisco, Cal., has just recently shipped to the Peninsular Power Company, of Madison, Wis., seven 70,000-volt, type 166, electrically operated oil switches, part of a repeat order for eleven switches of this type, which have been in use by the latter concern for several years.

Century Electric Company Doubling Floor Space.—On moving into its new eight-story modern reinforced-concrete building, whose ground dimensions are 75 ft. by 115 ft., the Century Electric Company, St. Louis, will expand each of its departments, and will occupy about twice the floor space taken up by the present factory. Electrical energy for driving the factory machines will be delivered from the mains of the Union Electric Light & Power Company at 13,200 volts, with a frequency of twenty-five cycles.

Electric Vehicles Shown in Louisville.—Electric vehicles had a prominent place at the annual automobile show in Louisville, Ky., held Feb. 11-14 at the big First Regiment Armory in the Kentucky metropolis. The Kentucky Wagon Manufacturing Company, of Louisville, showed a full line of its electric trucks, while other electric vehicles shown include the Detroit, Waverley, Rauch & Lang, Baker, Ohio, Chicago and Woods. Dealers in electric vehicles report that sales of this type of car have been rapidly increasing during the past few years.

Interurban Construction Work Resumed in Wisconsin.—The Badger Railway & Light Company, 403 Grand Avenue, Milwaukee, Wis., has given the contract for the construction of an electric railway between Lake Geneva and Whitewater, Wis. (a distance of about 22 miles), to the Raulf Construction Company of Milwaukee. This contract includes all necessary grading, ties, rails, trenching, railroad crossings, special work, telephone equipment, etc. This contract is said to be the first of its kind to be awarded since the creation of the Railroad Commission of Wisconsin.

Goodman Manufacturing Company Celebrates an Anniversary.—About 280 persons attended a dinner given by the Goodman Manufacturing Company at the Hamilton Club, Chicago, on Feb. 2. The event marked the completion of twenty-five years' business by the Goodman company and its predecessors, the Independent Electric Company and the Sperry Electric Mining Machinery Company. Elmer A. Sperry, of New York, gave an illustrated address on applications of the gyroscope, and speeches were also made by Frank S. Washburn, Judge J. A. Baldwin and H. E. Goodman.

Argentine Commercial Customs.—Supplementing a note in the Feb. 21 issue on the South American customs concerning foreign business representatives, the following information may be of value to American electrical manufacturers and others who are anticipating export trade with Argentina: The license taxes on commercial travelers in the several Argentine provinces vary greatly and are subject to frequent change. The lowest rate recorded is about $50 per year and the highest is about $500 per year, with an average of about $200 per year. The character of the goods handled and the number of lines carried bear some relation to the rate. In all but one province the licenses run from the issue date to Dec. 31, but in some of them reductions are made when the issue date is later than June 30. A special license is required for transacting business of this kind in the city of Buenos Aires, and this license covers also the national territories. Agents' samples, classing as dutiable merchandise, are admitted duty free for a maximum period of ninety days, on furnishing of satisfactory security for the payment of the regular duty, in case of sale or failure to re-export within the given time for any other reason.

Branch Offices of Bureau of Foreign and Domestic Commerce.—Branch offices of the Bureau of Foreign and Domestic Commerce have been opened in New York, Chicago, New Orleans and San Francisco, where the bureau's publications, samples of foreign-made products, plans and specifications of construction work abroad, lists of foreign dealers in various lines, manuscript consular reports and similar documents are available to interested individuals and firms. Reserved addresses in connection with "Foreign Trade Opportunities" published in the Daily Consular and Trade Reports may be obtained by application in letter form to these offices. It is suggested that firms in the districts served by these branch offices acquaint themselves with the material available through them, as time may frequently be saved by application to the branch office instead of the bureau at Washington. The addresses of the branch offices are as follows: New York, Room 315, United States Custom House; Chicago, 629 Federal Building; New Orleans, Association of Commerce Building, and San Francisco, 76 and 78 Appraisers' Stores Building.

Co-operative Freight Station Saves Dealers Delays.—Cupples' Station, St. Louis, Mo., is one of the few co-operative freight depots in this country, and the dispatch with which incoming and outgoing freight is handled for dealers and manufacturers in the association recommends the plan for other similar districts. The station was originally endowed by Samuel Cupples, of the Cupples Envelope Company, and it has since been maintained from a portion of the rents collected from property in the vicinity of the depot, whose occupants use the freight service. The St. Louis branches of both the General Electric Company and the Western Electric Company are shipping from Cupples' Station and it is said that delays with this system have been reduced to a minimum. Mixed cars consigned to several firms at Cupples' Station are unpacked at the co-operative depot and each firm's goods loaded upon separate trucks. These trucks are then driven to the back doors of the respective recipients. Outgoing freight is handled in a similar manner, loaded trucks being set at the back doors to be picked up by the station employees and made up into filled cars at the depot. Delays incident to handling freight through crowded railway terminals are in this way avoided, the firms still retaining all the advantages that accrue from carload shipments.

Expansion of a Maine Utility System.—In the Nov. 22 issue of the *Electrical World* note was made of the consolidation of the Cumberland County Power & Light Company and the York Light & Heat Company, both operating in the State of Maine and controlled by E. W. Clarke & Company, of Philadelphia. Word has just been received to the effect that the former company has secured right-of-way for a transmission line connecting its system to the lines of the York company. The new line will be a single-circuit, three-phase, sixty-cycle section, operating at a pressure of 38,000 volts and costing about $45,000. Contracts for the poles, towers and electrical apparatus have been placed, and it is proposed to complete the construction during the spring. The Cumberland County Power & Light Company recently constructed a new tie line, 12 miles long, between its hydro-electric stations at Bonny Eagle and North Gorham, in Cumberland County. The linking of these plants and of a third at West Buxton completes a double transmission line which insures continuous service to Portland, Maine, and vicinity and makes it unnecessary, except during seasons of unusually low water, to operate the auxiliary steam generating stations. For the year ended Dec. 31, 1913, the Cumberland County Power & Light Company made an excellent showing. Gross earnings and net earnings gained 10.6 per cent and 12.4 per cent, and surplus also increased.

Recent Sales of Morris Turbines.—The I. P. Morris Company, of Philadelphia, Pa., has recently received orders for turbines from the following utilities: The Turners Falls Company, Turners Falls, Mass., has contracted for the design and construction of three 9700-hp turbines to operate under a head of 54 ft. at a speed of 97.3 r.p.m., to be installed in its new hydroelectric plant on the Connecticut River. The Canadian Light & Power Company, of Montreal, Canada, has awarded the contract for one 7200-hp turbine to operate under a head of 48 ft. at a speed of 150 r.p.m. This turbine is of the horizontal-shaft, twin-volute casing type. The contract also includes an I. P. Morris governor. The Pennsylvania Water & Power Company has awarded the contract for one 16,500-hp vertical-shaft, single-runner turbine, with I. P. Morris governor, for its plant at Holtwood. The existing power-house substructure is arranged for ten vertical-shaft, two-runner units, of which type seven units have already been installed. The vertical-shaft, single-runner unit, with spiral casing formed in the concrete, will be installed in No. 8 setting, and slight modifications of the substructure will be required to accommodate this type of wheel.

Electrical Display at Building Material Exhibit.—An interesting permanent exhibit of building materials is on view on the second floor of the Insurance Exchange, 175 West Jackson Boulevard, Chicago. All sorts of building material, supplies and devices are exhibited in attractive fashion, the exhibit company utilizing the entire floor. It is said that the entire exhibit occupies about 22,000 sq. ft. It has been divided into exhibit spaces of various sizes and there are assembly and committee rooms as well as a reading room. Several electrical concerns have exhibits, the most conspicuous being that of the Commonwealth Edison Company, which, in addition to a very handsome collective display of electrical supplies and fittings in showcases, has a model of a two-story house cut in half to show the interior fittings. The house is equipped with miniature lighting fixtures, switches, electric washing machine, electric vacuum cleaner, floor outlets and all the other electrical accessories of the most up-to-date residence. The various models are carefully made to scale and this "doll's house," which perhaps stands 6 ft. from the first floor level, is in every way a dainty and interesting attraction. Among other exhibitors of electrical appliances are the Eden Washing Machine Company, Conlon Washing Machine Company, Capitol Washing Machine Company, Atwood Vacuum Cleaner Company, Premier Vacuum Cleaner Company, Burdett-Rowntree Company, Robert W. Hunt & Company and Electric Products Company.

Recent Purchases of Electric Apparatus.—Generating and motor apparatus and accessory electrical equipment have been ordered from the General Electric Company recently by a number of industrial concerns, the variety of the service to which this equipment is turned being shown by the following record: The Texas Portland Cement Company, Dallas, Tex., has arranged to make a large installation of apparatus for electric drive in its mills, comprising seventy-one motors ranging from 5 hp to 500 hp, with switchboard, controllers and accessories. The Dunellen Phosphate Company, Rockwell, Fla., is equipping its plant for electric drive and will install fifteen motors ranging from 50 hp to 300 hp. The Oklahoma Portland Cement Company, Ada, Okla., will place in operation in its power plant a 500-kw Curtis horizontal turbo-generator and a 625-kva alternating-current generator. The Oneida Community, Oneida, N. Y., will equip a power plant at Sherrill, N. Y., with a 750-kva Curtis turbo-generator. The Chicago & Alton Railroad Company, Bloomington, Ill., will install in substations four 300-kva two-unit three-bearing motor-generator sets, three 150-kva transformers and switchboard apparatus. The Boston & Maine Railroad Company, Boston, Mass., will add to the equipment of the power station at the east portal of the Hoosac Tunnel three 1500-kva water-cooled transformers. The Upper Hudson Stone Company, New York, will install electric-drive equipment in its plant at Marlboro, N. Y., consisting of five motors ranging from 50 hp to 300 hp, three 200-kva transformers and switchboard apparatus. The Hebard Cypress Company, Hebardville, Ga., will place in operation in its power plant a 750-kva Curtis turbo-generator and switchboard. The American Bottle Company, Streator, Ill., will equip its power plant with a 500-kw Curtis turbo-generator complete with switchboard and accessories. The Crescent Portland Cement Company, Wampum, Pa., has ordered for power-plant equipment a 2500-kva Curtis turbo-generator with switchboard apparatus. The Alpha Portland Cement Company, Philadelphia, Pa., will add electric apparatus to the equipment of its plant, including four 1000-kw rotary converters, four 1050-kva water-cooled transformers and a switchboard. The Singer Manufacturing Company, South Bend, Ind., has ordered two 2500-kw Curtis turbo-generators with 75-kw turbo-exciters, a 300-kw generator and accessories. In addition to the apparatus above mentioned a large amount of equipment has been ordered recently from the General Electric Company by operating companies. The Great Northern Power Company, Duluth, Minn., has purchased for installation at Fond du Lac, Minn., a 12,000-kva alternating-current generator, a 12,000-kva water-cooled transformer and accessories. The Mount Whitney Power & Electric Company, Visalia, Cal., will add to the equipment of its power stations twenty 500-kva transformers. The Appalachian Power Company, Bluefield, W. Va., has ordered a 345-kva motor-generator set and three 125-kva transformers. The Central Iowa Light & Power Company, Fort Dodge, Ia., will install three 300-kva transformers, switches and accessories.

Foreign Generating Station Projects.—Continued activity is seen in many foreign countries in the expansion of electric generating facilities. In India there are large power resources, and these are being gradually developed, accompanied by the general progress of the country along industrial lines. The first hydroelectric plant in that country was installed in Darjeeling in 1896, and the most important installations are at Cauvery Falls, near Mysore, and at Tata, near Bombay. The capacity of the Cauvery Falls plant is being increased at the present time, and a plant is being built in Afganistan which will be equipped with generating machinery of American make. In Sweden still greater activity in this direction is apparent. Generating plants for municipal service, aggregating 9200 hp, are under construction, and the iron-fabricating, mining and pulp-mill industries are increasing their generating capacities in the same proportion, so that about 33,000 hp additional capacity is anticipated with the completion of present projects. Several single plants of large capacity have been just recently finished. Plans are under way in the Austrian cities of Graz and Marburg for the erection of a large hydroelectric generating station on the Drave River. About 24,000 hp will be furnished by this station when completed, and it is expected to cost in the neighborhood of $2,500,000. At Wenchow, in the province of Chekiang, China, there is a generating plant now under construction in which American apparatus and American engineering are used exclusively. This station is being built by Anderson, Meyer & Company, the Shanghai representatives of the General Electric Company, and its rating is about 1500 kw.

NEW YORK METAL MARKET PRICES

	Feb. 17		Feb. 24	
	Bid	Asked	Bid	Asked
Copper:				
Standard spot*	14.12½	14.50	13.75	14.37½
	Selling Prices		Selling Prices	
	£ s. d.		£ s. d.	
London, standard, spot*	65 2 6		64 12 6	
Prime Lake	14.87½ to 15.12½		14.75 to 14.87½	
Electrolytic	14.60 to 14.70		14.50 to 14.60	
Casting	14.40 to 14.50		14.30 to 14.40	
Copper wire base	15.75 to 16.00		15.75 to 15.87½	
Lead	4.00		4.00	
Nickel	40.00 to 45.00		40.00 to 45.00	
Sheet zinc, f.o.b. smelter	7.25		7.25	
Spelter, spot	5.40 to 5.45		5.40 to 5.50	
Tin, spot	39.65 to 39.85		38.50 to 39.00	
Aluminum:				
Prompt delivery	18.75 to 19.00		18.50 to 18.75	
Future	18.50 to 18.75		18.50 to 18.75	

***OLD METALS**

Heavy copper and wire	13.75	13.75
Brass, heavy	8.87½	8.87½
Brass, light	7.87½	7.87½
Lead, heavy	4.05	4.05
Zinc, scrap	4.25	4.25

***COPPER EXPORTS**

Total tons to Feb. 24 25,800

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

El Paso Electric Company Increases Dividend Rate.—The El Paso (Tex.) Electric Company, a Stone & Webster property, has declared a quarterly dividend of $2.25 per share on its outstanding stock, representing an increase of 25 cents per share per quarter.

California Utility Planning Bond and Note Issues.—The San Joaquin Light & Power Company has made application to the California Railroad Commission for approval of an issue of $3,145,000 refunding bonds and an issue of $200,000 of short-time notes, for meeting present expenses.

Massachusetts Utility Plans Stock Increase.—The Board of Gas and Electric Light Commissioners has authorized the Cambridge (Mass.) Electric Light Company to issue 500 shares of new capital stock at $200 per share to meet the cost of plant extensions. The proceeds of 425 shares are to be devoted to the cancellation of notes outstanding on Dec. 31 and the proceeds of seventy-five shares to the payment of the cost of additions made since that date.

Brooklyn Companies' Directors Re-elected.—At the stockholders' meeting of the Kings County Electric Light & Power Company and the Edison Electric Illuminating Company of Brooklyn, on Feb. 24, the following directors were re-elected for the ensuing year: Frank Bailey, William Berri, J. C. Brady, N. F. Brady, W. C. Courtney, D. J. Creem, H. C. Du Val, Walton Ferguson, Bernard Gallegher, W. V. Hester, A. T. Kiernan, T. E. Murray, W. F. Sheehan, J. N. Wallace and W. F. Wells.

National Carbon Company Declares 50 Per Cent Stock Dividend.—A 50 per cent common-stock dividend was recently declared by the directors of the National Carbon Company, of Cleveland, Ohio, following the announcement of an increase of $7,600,000 in the capital stock of the company. The dividend is payable March 20 to holders of the 55,000 shares of common stock on March 10. At the same time announcement is made of the election of Conrad Hubert as vice-president and director, succeeding Webb C. Hayes. The annual report of the company for the year ended Dec. 31 showed net earnings of $1,476,622, combined preferred and common dividends of $645,000, and a balance of $495,907. The combined assets of the company are given as $11,695,121.

First Six Months of Mississippi River Power Company.—Gross earnings for the first six months' operation of the Mississippi River Power Company's property at Keokuk, Ia., amounted to $612,578. The operating expenses are given as $18,111 for the month of December alone. The largest single contract held by the company is for 60,000 hp to be delivered for distribution in St. Louis, Mo., and it holds numerous contracts with the smaller towns in the vicinity. The aggregate load contracted for so far is 88,000 hp, and on a delivery of 80,000 hp in December the gross earnings amounted to $123,040. Stone & Webster estimate the 1914 statement as: Gross earnings, $1,700,000; operating expenses, $300,000; bond interest charges, $990,000; balance for dividends, $200,000.

Milliken Brothers, Inc., Show Favorable Annual Report.—In the Jan. 3 issue of the *Electrical World* an account was given of the arrangements by which the Milliken Brothers Company was taken over by the new corporation. The report of Vice-president Francis Dykes, recently given out, contains some information of general interest that was not available at the former writing. Owing to the fact that the actual operations of the new organization covered only a few days in December, no statement of the results of that operation were included. The old company secured during 1913 work in eighteen different states and in six foreign countries. It constructed in the past year about 1000 miles of steel-tower transmission lines, of which the old company furnished the steel for about 800 miles. The volume of business in this field of the company's activities is subject, however, to large fluctuations from year to year. The output of the shops for 1913 was 34,389 tons. Mr. Dykes expressed the opinion that trade conditions appear to be gradually improving. The total assets of the company are given as $4,808,935, of which $1,129,000 represents capital assets and $1,273,041 current assets. The capital liabilities amount to $4,531,516.

American Public Utilities Company Growing.—Kelsey, Brewer & Company, who control the American Public Utilities Company, of Grand Rapids, Mich., have secured control of practically all the public utility rights in the Mississippi Valley between La Crosse, Wis., and St. Paul, Minn. In addition to the already extensive holdings of the American Public Utilities Company in Minnesota, the new deal takes over all the trolley properties of the Chippewa Valley Railway, Light & Power Company, which operates the street railway in Eau Claire and Chippewa Falls, together with the interurban line between these two cities, a distance of 22½ miles; the Chippewa Falls Water Works & Light Company, the Menominee Electric Light & Power Company, the water-power plant at Menominee, and rights along the Red Cedar and Chippewa Rivers with a capacity for developing approximately 100,000 electrical hp, together with other public utilities in Menominee, Elmwood, Spring Valley and other small adjacent towns. The deal covers an approximate investment of $3,000,000. These new holdings will be operated by Kelsey, Brewer & Company in connection with properties already controlled in Minnesota and Wisconsin.

Carolina Power & Light Company Report.—The report of President C. E. Johnson of the Carolina Power & Light Company, recently issued, covers many interesting data on that company, as well as on its subsidiaries, the Yadkin River Power Company and the Asheville Power & Light Company. The three concerns serve a population of about 134,000, and at the beginning of the present year had an aggregate connected load of 36,390 hp. in comparison with 12,504 hp. on Jan. 1, 1912. The first-mentioned company was incorporated in 1908 and now operates 188 miles of high-tension transmission lines, connecting two hydroelectric and three steam generating plants, with an aggregate capacity of 10,000 hp. Its gross earnings during 1913 amounted to $525,213; net earnings came to $190,655 in the same period, and a balance of $105,019 was realized. The Yadkin River company owns and operates a hydroelectric generating station of 32,000-hp rating on the Yadkin River, at Blewett Falls, N. C., and has in operation also 184 miles of high-tension transmission line. The Asheville Power & Light Company has its own generating stations, but is now purchasing energy, under a favorable contract, from the North Carolina Electrical Power Company. The combined statistics for the three companies show, for the year 1913, 8587 electrical customers, 76,668,656 kw-hr. feder output, gross earnings of $1,121,849, net earnings of $548,270, and a balance of $176,302.

Annual Report of Commonwealth Edison Company.—At the regular annual stockholders' meeting of the Commonwealth Edison Company of Chicago, on Feb. 24, President Samuel Insull reported that for the year 1913 the operating revenue of the company was $16,838,743. Deducting operating expenses of $7,957,300 and depreciation of $1,547,127 left net operating revenue of $7,334,316. Taxes and municipal compensation to the amount of $1,353,916 were paid. Adding to operating income a comparatively small amount for other income, the total net income of the company for the year 1913 was $6,241,927. From this was paid $1,600,000 in bond interest and $544,000 was set aside for depreciation reserve under the requirements of the company's general mortgage. There was paid in dividends $2,816,864. The amount carried to surplus account was $1,281,063, and this account on Dec. 31, 1913, stood at $2,838,210, a stock dividend of $3,695,000 having been paid during the year in addition to the cash dividends. The income of the company for the year 1913 was $1,477,094 greater than in 1912. On Oct. 19, 1913, the consolidation with the Cosmopolitan Electric Company was effected. This brought to the Commonwealth company over 5000 new customers. On Sept. 26, 1913, the company's authorized capital stock was increased from $40,000,000 to $50,000,000. The stock dividend heretofore referred to and declared from the company's surplus amounted to 10 per cent of the outstanding capital stock as of Oct. 4, 1913. The additional 10 per cent capital stock issued at par to stockholders was fully subscribed. The company has issued capital stock to the amount of $45,838,936 and there are outstanding bonds to the amount of $32,000,000. The depreciation reserve stands at $4,521,839, and the total assets of the company are given as $87,626,505.

Business Notes

The Kentucky Electrical Company, Owensboro, Ky., has entered the manufacturing field with a drawn-wire tungsten lamp.

The Wagner Electric Manufacturing Company, St. Louis, Mo., is opening an office at 731 Wells Building, Milwaukee, Wis. W. R. Patton, formerly of the Chicago office, will be manager of the office at Milwaukee.

The S. D. Dalbey Electric Company is the new name of the Katterjohn & Dalbey Electric Company, of Paducah, Ky. The concern has purchased the building that it now occupies at 525 Broadway and will remodel and enlarge it. The firm does a general electrical contracting business and is planning to enter the jobbing field, handling electrical supplies in larger quantities.

The Edison Storage Battery Company, Orange, N. J., has recently made two important organization changes. W. F. Bauer, formerly manager of the railway department of the United States Light & Heating Company in Chicago, has been made assistant manager of the Edison company's railway department, retaining his headquarters in Chicago, at 2025 Michigan Avenue. Bertram Smith, lately manager of the battery department of the United States Light & Heating Company in Chicago, has been appointed assistant manager of the Edison Storage Battery Supply Company of San Francisco, which handles the Pacific Coast business of the Edison Storage Battery Company. Both men were at one time connected with the National Battery Company, before its absorption by the United States Light & Heating Company.

The Holophane Works of the General Electric Company opened on Feb. 1 a district office in the Frisco Building, St. Louis, Mo., from which sales in the states of Iowa, Nebraska, Missouri, Kansas, Oklahoma, Texas, Louisiana and Arkansas will be directed. J. G. Barrett is in charge of this office, with R. H. Lyon as his assistant. A complete display room has been equipped and a full line of Holophane products can be seen at this location. The Chicago district office has been transferred from 425 South Wabash Avenue to Room 715, Mallers Building. The territory covered by this office has also been increased to include North and South Dakota, Minnesota and Wisconsin. J. W. Foster is sales manager in the Chicago district. R. E. Perry, who has handled Holophane sales in the Cleveland district, has been transferred to the Chicago district, with headquarters at Minneapolis.

New Industrial Companies

The Independent Electrical Supply Company, of Los Angeles, Cal., has been incorporated with a capital stock of $25,000 by I. E. Irvine, James Irvine and Hyman Schwartz.

The Wagga Company, of New York, N. Y., has been chartered with a capital stock of $50,000 to manufacture and deal in electric supplies and novelties, by L. E. Warren, C. A. Burr and O. H. Cacciola, of New York, N. Y.

The Maroa Manufacturing Company, of Maroa, N. Y., has been incorporated by G. Conover, H. R. Harpstrite and J. A. Worsham. The company is capitalized at $25,000 and proposes to manufacture mechanical and electrical specialties.

The Electrical Maintenance Company, of Youngstown, Ohio, has been incorporated by Max Hain, Samuel Hain, Mark Gunlefinger and E. Gunelfinger. The company is capitalized at $25,000 and proposes to do a general contracting business.

The Service Battery Company, of Chicago, Ill., has been incorporated with a capital stock of $5,000 to deal in storage batteries, electric supplies and automobile parts. The incorporators are Nathaniel A. Stern, Maurice Alschuler and M. Richardson.

The Penn Yan Cable Company, of Penn Yan, N. Y., has been incorporated with a capital stock of $50,000 by E. R. Ramsey, W. H. Neefus and G. S. Sheppard, of Penn Yan. The company proposes to manufacture and deal in insulating safety devices.

The Acorn Insulated Wire Company, of Brooklyn, N. Y., has been chartered with a capital stock of $100,000 to manufacture and deal in insulated wire. The incorporators are Walter V. Donovan, 34 Pine Street, New York; Joseph Quittner and Joseph T. McMahon, New York, N. Y.

The Bourn Insulated Wire & Cable Company, of Portland, Maine, has been incorporated with a capital stock of $150,000 to manufacture and deal in insulated wire and cables, rubber and all allied products. J. H. Pierce, of Portland, Maine, is president and S. W. Bourn, of Providence, R. I., is treasurer.

The Bond Electric Company, of Hornell, N. Y., has been organized with a capital stock of $10,000 for the purpose of doing a general contracting and electrical engineering business and to deal in supplies. The directors are P. M. Bond, Hornell; W. S. James and C. D. Miller, both of Buffalo, N. Y. P. M. Bond is general manager.

Trade Publications

Charging Outfits.—A booklet, size 2¾ in. by 9½ in., has been issued by the Electric Products Company, Cleveland, Ohio, referring to the "Vertical Wotton" charging outfits for use in unattended garages.

Vacuum Cleaner.—The Menominee Electric Manufacturing Company, Menominee, Mich., has issued a folder on its "Menominee" vacuum cleaner, in which are illustrated and described the construction features of this modern labor-saving device.

Copper Prices.—The Rome Wire Company, Rome, N. Y., has compiled and printed in leaflet form a copper history as told in prices. A table is printed showing the monthly average price of copper from 1884 to 1914. The yearly average for 1913 was 15.833 cents.

Connectors.—A four-page leaflet bearing the imprint of the Delta Star Electric Company, 617 West Jackson Boulevard, Chicago, Ill., refers to Dossert connectors for tapping high-tension leads to high-tension buses and other purposes. The leaflet is fully illustrated.

Electric Stoves.—A booklet issued by the Olston Electric Stove Company, Inc., 217 Mercantile Place, Los Angeles, Cal., illustrates its portable and wall types of electric stoves. Some practical data are given as to the operation of the portable electric range and its advantages are clearly set forth.

Steam and Oil Separators.—The Harrison Safety Boiler Works, 3159 North Seventeenth Street, Philadelphia, Pa., have just issued a thirty-six-page pamphlet as an introduction to their general separator catalog, which latter will treat the separator problem in five main sections. The introductory pamphlet touches briefly on the main points to be considered in connection with both oil and steam separators.

Aluminum.—"Aluminum in the Construction of Chemical Plants" is the subject of publication No. 144, issued this month by the British Aluminum Company, Ltd., 109 Queen Victoria Street, London, E. C., England. The use of aluminum in the chemical industry for almost every chemical process is discussed in this pamphlet, and many interesting facts are given, as well as tables showing the comparative physical and mechanical properties of brass, steel and aluminum, weight of aluminum sheets and sizes and weights of aluminum tubes.

Mine Locomotives.—A pamphlet on Baldwin-Westinghouse electric mine locomotives has just been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and the Baldwin Locomotive Works, Philadelphia. The pamphlet describes the construction of the modern electric locomotives and the illustrations show construction details. The new bar-steel frame locomotive is described and illustrated and also controllers, circuit-breakers, trolleys and gathering reels. Specification blanks for mine-haulage locomotives are included.

Personal Mention

Mr. Thurston Owens has resigned as general manager of the La Crosse (Wis.) Gas & Electric Company.

Mr. John Vanderwerp has been elected president of the Muskegon (Mich.) Traction & Lighting Company as successor to the late F. A. Nims.

Mr. H. A. Lewis, New York manager of the Hot Point Electric Heating Company, sailed for Europe two weeks ago and will be absent for about a month.

Mr. C. R. Ablett has been appointed New York sales manager of the Hygrade Incandescent Lamp Company and Bay State Lamp Company as successor to the late James Kennedy.

Mr. August Weiss, superintendent of the electrical department of the Citizens' Light, Heat & Power Company, Johnstown, Pa., has been appointed assistant to the general manager, Mr. P. J. Morrissey.

Mr. John Wales has been appointed manager of the Boston sales office of the American Electrical Works to fill the vacancy caused by the appointment of Mr. R. W. Lillie as New York sales manager.

Mr. Henry Madison has been appointed chief electrician of the new municipal lighting plant at Franklin, N. J. Mr. Madison was formerly connected with the Newton Gas & Electric Company, Newton, N. J.

Mr. W. F. Gilmen, formerly superintendent of District D for the Central Illinois Public Service Company, with headquarters at Tuscola, Ill., has been transferred to Jacksonville, Ill., and is to have charge of Districts I and G.

Mr. J. B. Anderson, for many years engineer of power stations of the Savannah (Ga.) Electric Company, has been transferred to the Baton Rouge (La.) Electric Company. He will become superintendent of lighting in Baton Rouge on March 1.

Mr. J. Beaumont, until recently signal engineer of the Chicago Great Western Railroad, with headquarters in Chicago, has resigned to become senior signal engineer of the board of railroad valuation engineers of the Interstate Commerce Commission.

Mr. A. G. Gibbony has been appointed manager of the Burlington Power Company, with headquarters at West Burlington, Ia. For the past five and a half years Mr. Gibbony was superintendent of the Massena (N. Y.) Electric Light & Power Company.

Mr. Samuel Scovil, formerly vice-president of the Cleveland (Ohio) Electric Illuminating Company and well known in the electrical industry as the active head of that corporation, has been elected president of the company as successor to Mr. James Parmelee, retired.

Mr. R. W. Lillie has been appointed manager of the New York sales office of the American Electrical Works, vice Mr. Frank Donahoe, resigned. Mr. Lillie was formerly in charge of the Boston sales office and previous to that served for five years with the Holtzer-Cabot Electric Company.

Mr. W. R. Patton, for several years in charge of out-of-town sales in the Chicago office of the Wagner Electric Manufacturing Company, has been appointed manager of the new Milwaukee office of the same company. Mr. Patton is a Jovian of low potential and an electrical man of wide acquaintance.

Mr. E. W. Reed, who has been general superintendent of the Chattanooga (Tenn.) Railway & Light Company for some years, has been continued in that capacity with widened authority. The office of general manager has been abolished, and to Mr. Reed have been given all powers formerly exercised by such an official. He will have complete authority in the operation of both the street-railway department and the electric-light department of the corporation.

Mr. James Parmelee has resigned as president and director of the Cleveland (Ohio) Electric Illuminating Company and has been succeeded as president of the company by Mr. Samuel Scovil, and by Mr. Harrison Williams, of New York, as chairman of the board of directors. Mr. Parmelee, with Mr. Myron T. Herrick and their local financial following, sold the controlling interest of the Cleveland Electric Illuminating Company more than a year ago to the Central States Electric Corporation.

Mr. Putnam A. Bates, consulting engineer of New York City, has been appointed chief of the Bureau of Fire Alarm Telegraph of New York City by Fire Commissioner Adamson. Mr. Bates, who is well known in engineering circles in New York, is a graduate of Columbia University, and the heating and lighting plant in the Engineers' Club of New York City and that for the group of buildings in Hartford, Conn., erected by the late J. P. Morgan in memory of his father are among the many plants designed by him.

Mr. Julius C. Smith, manager and chief engineer of the Shawinigan Water & Power Company and also hydraulic engineer of the Cedar Rapids Manufacturing & Power Company, both of Montreal, has been awarded the Gzowski medal by the Canadian Society of Civil Engineers for his paper on "High-Voltage Transmission Lines." The silver medal which is struck off yearly and paid for by a fund provided for that purpose by the late Col. Sir Casimir Gzowski, past-president of the Canadian Society of Civil Engineers, is awarded on the recommendation of a committee of five for the best paper presented before that society during the year.

Mr. F. W. Hoover, who is general manager of the Tennessee Power Company, one of the two companies which have developed 150,000 hp in the Chattanooga district, has been designated executive officer of the Chattanooga (Tenn.) Railway & Light Company, reporting directly to Mr. M. H. Hopkins, first vice-president. Mr. Hoover is second vice-president of the railway and light company, having been elected to that office by the directorate in Philadelphia some time ago. He was in a position of authority with the Chattanooga Railway & Light Company prior to the resignation of Mr. W. E. Boileau as general manager of that company, which is controlled by the Clarks of Philadelphia. Mr. Hoover continues to act as general manager of the Tennessee Power Company, with offices in the Hamilton National Bank Building, Chattanooga, Tenn.

Mr. Theodore Beran, New York district manager for the General Electric Company, was the guest of a number of his friends and business associates at a dinner at the Machinery Club, New York, Feb. 20, to mark the twenty-fifth anniversary of his advent into the electrical field. It was in 1889 that Mr. Beran became cashier for the old Sprague Electric Company, which afterward, merging with the Edison General and Thomson-Houston companies, became the present General Electric Company. In 1893 Mr. Beran was appointed manager of its supply department, and he continued in that position until 1902, when he went to Rugby, England, where he organized the supply department of the British Thomson-Houston Company. After two years abroad, he returned to New York City and succeeded Mr. Charles T. Hughes as acting manager of the New York district office of the General Electric Company. Since 1905 Mr. Beran has served as district manager.

Obituary

James Kennedy, for twelve years manager of the New York office of the Hygrade Incandescent Lamp Company and the Bay State Lamp Company, both of Danvers, Mass., died of heart and kidney trouble last week.

Cecil A. Howell, superintendent of the test department of the Southern California Edison Company, Los Angeles, Cal., died at the Crocker Street Hospital, Los Angeles, Feb. 13, from the effects of a burn received the night before while superintending the installation of new instruments in the company's substation at Castaic.

Franklin Phillips, head of the foundry and machinery firm of Hewes & Phillips, died at his home in Newark, N. J., Feb. 9, from pneumonia. Mr. Phillips was born in Newark, N. J., fifty-seven years ago and was graduated from Cornell in 1878. He immediately became connected with the firm of Hewes & Phillips, founded by his father, and soon established a reputation as a mechanical, steam and hydraulic engineer. He was a trustee of the Newark Technical School, president of the Foundrymen's Association of New Jersey and a member of the Newark Board of Trade, the Essex Club and the American Society of Mechanical Engineers. He is survived by his widow, one son and a daughter.

Construction

New England

CLAREMONT, N. H.—The Claremont Paper Co. has begun work on the construction of a new power house. A 500-kw General Electric steam turbine will be installed.

CLAREMONT, N. H.—A petition has been in circulation asking the Public Service Commission to grant permission to the Sunapee El. Lt. & Pwr. Co., of Sunapee, to erect a transmission line into Claremont. Surveyors are still at work on the company's water-power project in Corydon.

WOODSTOCK, VT.—The Woodstock El. Co. expects to purchase some materials for its distribution and lighting system; also electrical appliances and supplies. Wilfred Smith is superintendent.

LUNENBURG, MASS.—At a special town meeting held recently the citizens voted in favor of establishing a municipal lighting plant and water-works system in Lunenburg.

WORCESTER, MASS.—Plans have been prepared for an addition of 20 ft. by 70 ft. to the Webster Street power house of the Worcester El. Lt. Co. Contract has been placed with the Westinghouse El. & Mfg. Co., of Pittsburgh, for a 6250-kw steam turbine.

Middle Atlantic

NIAGARA FALLS, N. Y.—Plans are being considered for connecting up the present ornamental street-lighting systems between the north and south ends of the city. The present plans provide for 160 steel trolley posts with single brackets part way and double brackets the rest of the way; 160 lamps or 254 lamps (not yet decided), to be maintained by overhead wires. The cost of the system is estimated to be $30,000 Mayor William McLaughlin is chairman of lighting committee and M. J. Donohue is city electrician.

ONEIDA, N. Y.—J. M. Hutton, city engineer, advocates the installation of a municipal electric-light plant. He recommends the development of a water-power site on Sconondoa Creek, near Knoxboro, 12 miles from Syracuse, which would develop sufficient power for lighting the city. The cost of the dam, installation of dynamo and erecting transmission line is estimated at about $30,000.

ONEIDA, N. Y.—Application has been made to the Public Service Commission by Holton V. Noyes, of Oneida, individually, also by Mr. Noyes as proprietor of the Kenwood El. Lt. Co. and the Oneida Community, Ltd., for construction of electric transmission lines and for the approval of franchises in the city of Oneida and the town of Vernon, together with the purchase of wires, poles and other appurtenances by Holton V. Noyes from the Oneida Community, Ltd., for $682.

SARATOGA SPRINGS, N. Y.—Bids, it is reported, are being received by Harry Croker for the installation of an ornamental lighting system, consisting of 48 lamps, in Saratoga Park, to cost about $4,000. It is reported that bids are being received by John C. Graul, superintendent of streets, for the installation of 60 ornamental street lamps and a conduit system on Broadway, to cost about $9,000.

BLOOMSBURG, PA. — Arrangements have been completed by the Columbia & Montour El. Co., of Bloomsburg, to extend its high-tension transmission line from Danville to Northumberland, and from there to Sunbury, where connections will be made with the high-tension line between that town and Milton.

COATESVILLE, PA.—If sufficient patronage is assured, the Chester Valley El. Co. may extend its system to Lionville and Byers to furnish electrical service in those towns. The company has a line to Bradford Hills.

ERIE, PA.—Plans are being considered for the installation of underground conduits on State Street from Eighteenth to Second Street, to be owned and maintained by the municipality, to cost approximately $50,000.

PITTSBURGH, PA.—The Department of Public Safety is considering the installation of an electric-light alarm system in connection with police department. Investigations are being made to ascertain the cost of the proposed system.

PITTSBURGH, PA.—Bids will be received by the board of inspectors, Western Penitentiary, North Side, Pittsburgh, until March 4, for furnishing and delivery f.o.b. cars, Rockview Station, Centre County, materials for construction of concrete building, including structural steel concrete tower complete, with chutes for elevating and placing concrete, Portland cement, reinforcing steel, etc.; also for furnishing and installing complete plumbing, heating and ventilation, electric wiring and equipment. Plans and specifications may be seen and proposal forms obtained at the following places: office of the board of inspectors, Western Penitentiary, Pittsburgh; at the prison, Rockview Station; Builders' Exchange, 18 South Seventh Street, Philadelphia; Builders' Exchange, Fulton Building, Pittsburgh; office of John T. Windrim, Commonwealth Trust Building, Puttsburgh, and at office of Thompson-Starrett Co., Second National Bank Building, Pittsburgh. John Francies is superintendent of construction.

POLK, PA.—Bids will be received by the board of trustees of the State Institution for Feeble-Minded of Western Pennsylvania, at the institution at Polk, until March 11, for the general construction of girls' cottage group, bakery building and addition to laundry building. Separate bids will be received for the plumbing, heating and electric work respectively. Plans, specifications and form of proposals can be seen at the institution and at the office of F. J. Osterling, architect, Commonwealth Building, Pittsburgh. Marvin F. Scaife is secretary and Dr. J. M. Murdoch is superintendent.

SELLERSVILLE, PA.—The Excelsior El. Lt., Pwr. & Gas Co., of Sellersville, expects to purchase ten transformers, 2 miles of wire and 25 meters within the next three months. F. Howe Kift is superintendent.

MERCHANTVILLE, N. J.—The Public Ser. El. Co. has submitted a proposal to the Borough Council for the installation of new 32-cp and 80-cp street lamps.

NEWARK, N. J.—A power house will be erected in conjunction with the new abattoir to be built by A. Fink & Sons, meat packers, at 810 Frelinghuysen Avenue.

NEWARK, N. J.—The Beaver Engineering Co., of Newark, has been awarded the contract for electrical work and elevators for the new Center Market, to cost about $30,000.

SOUTH RIVER, N. J.—Bids will be received by the Borough Council until March 9 for the construction of an addition to the municipal electric-light plant, including the installation of a gas producer, gas engine, generator and switchboard in accordance with plans and specifications prepared by C. S. Partridge, superintendent board of public works, which may be obtained from Charles Anderson, borough clerk, or C. S. Partridge, superintendent of public works.

RAVENSWOOD, W. VA.—At an election held Feb. 21 the proposal to construct a water-works system and to make improvements to the municipal electric-light plant was carried. As yet full details have not been arranged. C. O. Nilsson is superintendent of the municipal electric-light plant.

WASHINGTON, D. C.—A city council is considering the erection of an electric power plant for lighting the city, the installation of a brick-making plant with a daily capacity of about 4000 bricks and the construction of a water-works system. For further information address No. 12,503, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or the branch office of the bureau, Room 337, United States Custom House, New York, N. Y.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 10, for furnishing at the navy yard, Brooklyn, N. Y., the following supplies: Schedule 6303—steel sashes, operating devices, trolley track; Schedule 6304—asbestos sheets; Schedule 6305—aluminum wire, lead washers, iron or steel clips; Schedule 6401—furnishing and erecting electrically operated gentry crane; Schedule 6402—pneumatic tools; Schedule 6416—calcium chloride, etc.; Schedule 6419—electric cables; Schedule 6423—crucibles, electric wire, composition unions, etc. Applications for proposals should designate the schedule desired by number. Blank proposals will be furnished upon application to the New York navy pay office or to the above bureau. T. J. Cowie is paymaster general, U. S. N.

WASHINGTON, D. C.—A resident of a Latin-American country informs an American consulate that he would like to receive information from American firms able to supply the following classes of materials: Aerial cable systems, with a capacity for transporting 40 to 60 tons of coal per day of 10 hours, distance about 500 yd.; wire cables and fixtures for use in inclined mine entries, endless cable devices; railway materials, such as rails, flat cars, coal cars, mine cars, etc., gage of railway 42 in.; electric plants operated by steam power, gasoline motors, 1½ hp up, and gasoline launches for business purposes. For further information address No. 12,516, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or the branch office of the bureau, Room 337, United States Custom House, New York, N. Y.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 17 for furnishing at the various navy yards and naval stations the following supplies: Annapolis, Md., Schedule 6449—miscellaneous hydraulic apparatus, etc., miscellaneous galvanometers, etc. New London, Conn., Schedule 6457—two metal coal chutes; Schedule 6441—one engine-driven centrifugal pump. Norfolk, Va., Schedule 6454—100 brass-case, air-pressure gages (3-in., to read 160 lb.), 100 galvanized-steel air-whistle tanks (9 in. in diameter by 28 in. long); Schedule 6443—one vertical, double-acting, duplex pump, one vertical, double-acting, simplex pump; Schedule 6454—100 2-in. diameter compressed whistles, complete, miscellaneous screwed, low-pressure, rough composition pipe fittings, 276 lb. drawn, seamless brass tubing, 112 lb. drawn, seamless copper tubing, 200 2-in. screwed, low-pressure, rough-composition unions. Brooklyn, N. Y., Schedule 6458—one 12-in. reach, pneumatic compression punch; Schedule 6452—1100 ft. 9 in. (outside diameter) steel tubing (18.429 lb. per ft.). Washington, D. C., Schedule 6450—miscellaneous seamless brass pipe (iron pipe size), 2860 lb. miscellaneous seamless copper pipe (iron pipe size). Bids will also be received until March 24 as follows: Philadelphia, Pa., Schedule 6435—one oil-burning, water-tube testing boiler. Brooklyn, N. Y., Schedule 6439—11 centrifugal pumps; Schedule 6432—four 300-kw turbo-generator sets, with spare parts. Bids will also be received until March 31 as follows: Brooklyn, N. Y., Schedule 6459—for 12 turbine-driven forced-draft blowers. Bids will be received until April 7 for the following: East and west, Schedule 6462—annual supply of miscellaneous boiler gaskets. Bids will also be received until April 14 as follows: Pearl Harbor, Schedule 6433—miscellaneous lead-covered, paper-insulated cable, 40 ft. lead-covered, wool-insulated, telephone cable, miscellaneous telephone accessories and 6000 ft. twisted pair, telephone wire. Application for proposals should designate the schedule desired by number. T. J. Cowie is paymaster general, U. S. N.

North Central

BAY CITY, MICH.—The plant now being erected by Walter D. Young for the manufacture of the Aladdin houses in Salasburg will as far as possible be equipped with electrically driven machinery. Energy for operating the plant will be supplied by the Bay City Pwr. Co. The building will be 120 ft. by 350 ft.

DETROIT, MICH.—The contract for electric equipment in the new 10-story building for Gregory, Mayer & Thom, on Cadillac Square, Detroit, has been awarded to the Gray Brothers Electrical Co., of Detroit.

GRAND RAPIDS, MICH.—The merchants on West Leonard Street are agitating the question of installing an ornamental street-lighting system. They agree, it is reported, to furnish the lamp standards, provided the city will furnish the wire and maintain the lamps.

MONROE, MICH.—The River Raisin Paper Co., of Monroe, it is reported, is preparing plans for the construction of a new power plant. H. Wood, of Monroe, is owner, and James Gilmore, architect.

RIVERDALE, MICH.—The Alma Illuminating Engineering Co., of Alma, it is reported, is interested in a project to utilize the power of the Pine River developed at the J. W. Johnson dam. It is said that arrangements have been made for the erection of transmission line to furnish electricity for lamps and motors in Vestaburg, Riverdale, Elm Hall, Sumner, Elwell, Cedar Lake, and possibly Edmore and Alma.

CANTON, OHIO.—Application has been made to the City Council by O. C. Barber, of Akron, to supply electricity in Canton. The proposed electric plant is to be situated in Howenstein, a few miles from Canton, at the entrance to the coal mine there, owned by Mr. Barber. When the plant is completed electricity will be transmitted to Alliance, Massillon, New Philadelphia and other towns and cities.

CINCINNATI, OHIO.—Bids will be received by the board of hospital commis-

sioners, Burnet Avenue, Cincinnati, Ohio, until March 17 for furnishing material and construction of the administration building, nurses' home, dining hall, reception cottage, laundry and power building, stack and stable of the new Cincinnati Tuberculosis Hospital, and additions and alterations to porches on present ward buildings No. 2 and No. 3, in Lick Run, Hamilton County, as follows: (3) For reinforced concrete work; (4) brick work, cut-stone work, hollow-tile partitions and furring; (5) stack; (6) cork insulation; (7) carpenter work; (8) hardware; (9) structural iron and steel work; (10) lathing and plastering; (11) sheet-metal work and roofing; (12) painting and glazing; (13) tile and marble work; (14) cement work; (15) elevator work; (16) electrical work; (17) plumbing and gas fitting. Plans and specifications are on file in the office of hospital commissioners and the office of Tietig & Lee, architects, Lyric Building, Cincinnati. Proposals may be submitted on any branch of the work, on any number of branches, and for the work in aggregate, including all branches. Bids will also be received at the same time and place for labor and materials required in the heating and engineering work in the new Cincinnati Tuberculosis Hospital, Lick Run, as follows: (1) For boilers, stokers, smoke connection, coal cars, tracks and scales; (2) power piping, steam transmission lines and heating systems; (3) covering and insulation; (4) electric transmission system; (5) refrigerating plant; (6) laundry equipment. Plans and specifications are in file at the office of the hospital commissioners and in the office of Walter G. Franz, consulting engineer, Union Trust Building, Cincinnati. Proposals may be submitted on any branch of the work, on any number of branches, and for the work in aggregate including all branches. Frederick S. Speigel is president of the board and E. L. Kennedy is clerk.

DE GRAFF, OHIO.—The International Harvester Co. is reported to have submitted a proposal to the Village Council, offering to install an electric-light plant, to cost about $4,000. Kerosene oil engines are suggested.

LOWELLVILLE, OHIO.—The Mahoning & Shenango Ry. & Lt. Co., of Youngstown, has awarded the contract for the construction of a brick, steel and concrete power house in Lowellville to A. & S. Wilson. The company, it is said, expects to purchase new machinery and general equipment.

MASON, OHIO.—The Village Council has engaged Seidl & Hausman, Sweetland Building, Cleveland, to prepare plans for the installation of a municipal electric-lighting system in Mason.

SALEM, OHIO.—The Buckeye Engine Co., of Salem, has submitted a proposal to the City Council offering to furnish electricity to operate the new street cars and the water-works station.

ST. BERNARD, OHIO.—Bids will be received by the city of St. Bernard, addressed to William F. Rolf, director of public service, until March 2, for furnishing prime movers, boiler, generators, switchboard, etc., for the extension of the municipal electric-light plant, in accordance with plans and specifications on file in the office of the director of public service. Post office address, St. Bernard, Cincinnati, Ohio.

VAN WERT, OHIO.—The City Council is arranging for the installation of a new lighting system for the residential section of the city. It is proposed to use smaller lamps and increase the number.

WARREN, OHIO.—Within the next year the Trumbull Pub. Ser. Co., of Warren, expects to erect a substation in Niles, to be equipped with three 200-kw transformers and 22,000/2200-volt apparatus; also to purchase within the next 30 days one feed-water pump for 1200-hp boiler capacity and to purchase in the near future a series street-lighting panel, 6.6-amp. recording meter and constant-current transformer; also within the next few months to purchase a 2000-kw or 3000-kw steam turbine, condenser, etc., and electrolytic lightning arresters. The company is now in the market for electrical appliances, including heating and cooking apparatus, vacuum cleaners, washing machines, etc. M. L. Derge is general superintendent.

YELLOW SPRINGS, OHIO.—The Council is considering the question of issuing $1,000 in bonds for extensions to the municipal electric-light plant.

BOWLING GREEN, KY.—Plans, it is reported, are being prepared by Howard & Merriam, Capital Trust Building, Columbus, Ohio, for the erection of a power house for the Bowling Green State Normal College, to cost about $50,000.

CADIZ, KY.—Alexander Brothers & Co., of Cadiz, who operate an electric-light plant in connection with their ice factory, are planning to extend the lighting service to the business houses in the village.

CAVE CITY, KY.—A company, it is reported, is being organized to install an electric-light plant and ice factory. S. B. Davis is interested in the project.

COLUMBIA, KY.—Arrangements are being made by Green H. Smith for the erection of a flour mill, which will be equipped with electrically operated machinery. Energy will be secured from water-power on Russell's Creek.

HAZARD, KY.—The Hazard Lt. & Pwr. Co. will install two generators, one 100-kw alternating-current and one direct-current, directly connected to engines with necessary switchboard equipment and paralleling arrangements and one tower. Contracts will be awarded on March 15 and construction work will begin May 15. W. E. Hemphill, of Hazard, has charge of the work.

LOUISVILLE, KY.—The Merchants' Ice & Cold Storage Co., of Louisville, it is reported, will install two electric freight elevators. N. A. Hardin is manager.

LOUISVILLE, KY.—Plans are being considered by George Dunham, Paul Jones Building, Louisville, for the erection of a woolen mill in Louisville or vicinity, and he will install electrically operated machinery. Mr. Jones will probably install an electric generating plant.

MOREHEAD, KY.—The municipal electric-light plant in Morehead was destroyed by fire recently, causing a loss of about $10,000. The city officials, it is reported, are planning to rebuild the plant at once.

SHELBYVILLE, KY.—The Kentucky Utilities Co., of Shelbyville, is planning to construct an additional dam on Clear Creek for the purpose of increasing its water supply.

FORT WAYNE, IND.—The Fort Wayne & Northern Indiana Trac. Co., of Fort Wayne, has been authorized by the Public Service Commission to issue $600,000 in notes and $320,000 in bonds, the proceeds to be used for improvements and extensions to its system.

FORT WAYNE, IND.—Plans are being considered by the Municipal Electric Light Department for extensions to the municipal electric plant and distribution system. It is proposed to install an additional turbo-generator, build an addition to power house, etc., and erect 40 miles of distribution lines. F. J. Dix is superintendent.

CHICAGO, ILL.—Bids will be received by the city of Chicago at Room 406, City Hall, until March 7 for furnishing and installing one switchboard and accessories at the municipal reduction plant of the city of Chicago at Thirty-ninth and Iron Streets. Proposals must be made out on blanks furnished by the above office. George B. Young is commissioner of health.

JOLIET, ILL.—The Joliet Mfg. Co., it is reported, has decided to install an electric plant to supply electricity for lamps and motors for its factory in Cass Street.

URBANA, ILL.—Bids will be received by the University of Illinois, Urbana, until March 7 for construction of addition to power house and addition to library building at the University of Illinois. Plans and specifications may be obtained upon deposit of $10 from James M. White, supervising architect, University of Illinois, Urbana.

URBANA, ILL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 30 for construction, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Urbana, Ill. Drawings and specifications may be obtained from the above office or from the custodian of site at Urbana. O. Wenderoth is supervising architect.

GREEN BAY, WIS.—The Wisconsin Railroad Commission has granted the Wisconsin Pub. Ser. Co., of Green Bay, permission to purchase the property of the Minahan El. Co., of Green Bay; also authority to issue $110,000 in bonds to take up a like amount of bonds of the latter company.

LOWELL, WIS.—Preparations are being made by the Lowell El. Lt. & Pwr. Co. for the construction of an electric power plant to furnish electricity for lighting and industrial water-power at source. The equipment will include one 100-hp Samson waterwheel, two 37½-kw, three-phase, 60-cycle, 2300-volt, 1200-r.p.m. generators, two switchboards (48 in. by 24 in. by 1¼ in.), voltmeter (175-volt scale), ammeter (15-amp scale), six 75-kw (potential) 2200/110-volt, four 50-kw (current), four 4-kw, 2300/110/220-volt transformers, overhead-line materials for 5 miles of line (carrying distance 3 miles), 350 meters (approximately), 40 arc lamps (clusters), and 1200 incandescent lamps of 32 cp. The company will carry electrical supplies, including heating devices, etc. Contracts have not yet been awarded. The cost of the plant is estimated at about $10,000. Webster F. Pease is manager.

NEENAH, WIS.—The city of Neenah is contemplating purchasing the distribution system of the Wisconsin Trac., Lt., Ht. & Pwr. Co., which furnishes electricity here, and to secure energy from the company to operate the system. The contract with the company expires this year.

ROSENDALE, WIS. — The Wisconsin Railroad Commission has authorized the Wisconsin Lt., Pwr. & Milling Co. to issue $10,000 in capital stock, the proceeds to be used for the purpose of building and equipping a hydroelectric plant and erecting transmission system in the vicinity of Rosendale, Fond du Lac County.

GEORGETOWN, MINN.—We are informed that the Farmers' Elevator Co., of Georgetown, has not yet taken any steps toward the installation of an electric-light plant and probably will not install a plant. Reported in the issue of Jan. 21 to be contemplating the installation of a plant. Theodore Spelsin is secretary and treasurer.

HECTOR, MINN.—The Renville County El. Co., of Bird Island, has been granted a franchise to furnish electricity for lamps and motors in Hector. A transmission line will be erected from the company's plant in Bird Island to Hector.

LISMORE, MINN.—Bids will be received by the village of Lismore until March 18 for the construction of a municipal electric-light plant. Plans and specifications may be seen at the office of Earle D. Jackson, Capital Bank Building, St. Paul, Minn. Ned Smith is recorder.

MINNEAPOLIS, MINN.—The Power Distribution Co., which is now operating several plants on the Great Northern R. R., between Dassel and Delano, and also at Eden Valley, is erecting transmission lines to various other points in that territory and will eventually take its energy from the lines of the Union Pwr. Co., running from St. Cloud. The company is not making any arrangement to build a power plant in St. Cloud as stated in the issue of Feb. 7. W. Baer Ewing is vice-president.

NEW PRAGUE, MINN.—Bids will be received by the City Council of New Prague until March 10 for a 66-in. high-pressure horizontal tubular boiler in accordance with specifications on file in the office of John F. Bruzek, city clerk, from whom copies may be obtained.

WILLMAR, MINN.—Plans, it is reported, have been prepared for the installation of additional equipment in the municipal electric-light and water-works plant, which includes one 125-hp engine, one 150-hp engine and accessories, one 100-kva generator, one 150-kva generator, two exciters, one of at least 9 kw and the other of 12 kw, one six-panel switchboard with all necessary apparatus. It is understood that bids will soon be called for the above equipment.

BUFFALO, IA.—The Town Council has decided to call an election to submit the question of installing a municipal electric-light plant to the voters. A committee, consisting of S. H. Moorehead, LeRoy Eggers and George Rausch, has been appointed to make investigations and secure the probable cost of a plant.

SABULA, IA.—Plans are being considered by J. A. Bradley, of Sabula, for the erection of transmission lines into the country near Sabula to furnish electricity in the rural districts. Electricity for operating the system will be purchased from the local plant.

WATERLOO, IA.—Bids will be received by the Board of Supervisors of Black Hawk County, Waterloo, Ia., until March 20 for construction of building for poor and insane in accordance with plans and specifications prepared by J. G. Ralston, architect, Waterloo, which may be seen at the office of the county auditor, Waterloo, and of the architect after March 6. Separate bids will be received as follows: (a) general construction of building, including power plant; (b) heating and plumbing. Copies of plans and specifications may be obtained from the architect upon deposit of $15, which will be refunded upon return of same. J. J. Rainbow is auditor.

BISMARCK, MO.—The installation of an electric-light plant in Bismarck is reported to be under consideration.

KANSAS CITY, MO.—Bids will be received by the board of directors of the school district of Kansas City, at the office of the secretary of board in the Public Library Building, until March 19 for furnishing and installing the following: Plumbing, drainage and gas fitting; heating and ventilating apparatus; galvanized and sheet-iron work; pipe covering, fuel oil-burning equipment; air washer; automatic temperature regulation; electric generating sets and switchboard; electric

wiring, lighting fixtures; vacuum-cleaning system, program clock system and equipment for manual training shops in the new Central High School now being erected on Linwood Boulevard and Indiana Avenue, Kansas City. Plans and specifications may be seen at the office of J. H. Brady, chief engineer, 517 Finance Building, Kansas City. James B. Jackson, Jr., is secretary of board of directors.

RICHLAND, MO.—The Richland Lt. & Pwr. Co. will install an electric-light plant in Richland for which contract has been awarded to the Missouri Electrical Co., 1120 Chestnut Street, St. Louis, Mo. The equipment will consist of one Remington oil engine, Fort Wayne generator, switchboard equipment, one 5-kva, and seven 1-kva Fort Wayne transformers, voltmeter with 0-125-volt scale and three ammeters with 0-50-amp scales, 2½ miles of overhead distribution line and 100 Fort Wayne meters (type K5). G. J. Harris, of Lebanon, Mo., is engineer in charge.

MINOT, N. D.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 17 for the construction complete (including mechanical equipment, except elevator and approaches) of the United States post office and court house at Minot, N. D. Drawings and specifications may be obtained at the above office or at the office of the custodian of site at Minot. O. Wenderoth is supervising architect.

PORTLAND, N. D.—A special election will soon be held to vote on the proposal to issue bonds for the installation of a municipal electric-light plant.

DALLAS, S. D.—Within the next two months the Martin El. Lt. & Pwr. Co., of Dallas, expects to purchase a turbine and generator and electrical appliances and supplies, including heating and cooking apparatus, vacuum cleaners, washing machines, wiring supplies, etc. B. H. Martin is president and manager.

FLANDREAU, S. D.—The Flandreau Lt. & Pwr. Co. expects to erect a 9-mile 13,200-volt transmission line and to install 100 kw in 13,200-volt transformers within the next four months. A. H. Savage, of St. Paul, Minn., is treasurer.

DORCHESTER, NEB.—Bids will be received until March 6 for improvements to the electric-lighting system in Dorchester. The Martz Engineering Co., of Lincoln, has charge of the engineering work. M. M. Wall is city ilerk.

SIDNEY, NEB.—We are informed that bonds have not yet been sold for the proposed electric-light plant and an engineer has not been engaged as yet. Will probably begin work on the plant in the spring.

BARNARD, KAN.—Plans, it is reported, are being prepared by Henrici, Kent & Lowry, Reserve Bank Building, Kansas City, Mo., for a municipal electric-light plant and water works system in Barnard.

ESBON, KAN.—The city of Esbon will award contracts on March 18 for construction of an electric-light plant and waterworks system. Plans and specifications may be obtained from Henrici, Kent & Lowry, 715 Reserve Bank Building, Kansas City, Mo., upon deposit of $3. Boyd Chandler is city clerk.

HOLYROOD, KAN.—Plans are being prepared, it is reported, by E. E. Harper, consulting engineer, Grand Avenue Temple, Kansas City, Mo., for a municipal electric-light plant in Holyrood, to cost about $10,000.

LEAVENWORTH, KAN.—The Mayor and city commissioners are considering the question of establishing a municipal electric-light plant. J. H. Kirmeyer is city clerk.

LE ROY, KAN.—Bids will be received by the city of Le Roy until March 4 for furnishing material and construction of the municipal electric-light plant as follows: (1) For one 60-hp crude-oil engine erected complete, with piping, belt, etc., on foundation furnished by the city; (2) one 50-kva, three-phase generator with exciter attached, switchboard and street-lighting apparatus, delivered f.o.b. cars; (3) pole-line equipment, consisting of poles, wire, street-lighting equipment, f.o.b.; (4) power-house building, brick, 30 ft. by 45 ft., complete, including machinery foundations; (5) erection of generator, switchboard, etc., and construction of pole line, equipment and material furnished by the city. Specifications are on file at the office of the Mayor and city clerk, Le Roy, also at the office of E. T. Archer & Co., New England Building, Kansas City, Mo., where copies may be secured at $1 per section, or $3 for complete set, including drawings. S. A. Green is Mayor.

VERMILLION, KAN.—The installation of an electric-light system in Vermillion is under consideration. It is expected that an election will be called in the spring to submit the question to the voters. If the proposition carries electricity will be secured from the electric plant in Frankfort. In the issue of Feb. 14 it was stated that the city of Vermillion was contemplating the installation of a municipal plant. A. M. Cooke is city clerk.

Southern States

HAZLEWOOD, N. C.—Preparations are being made for the installation of a municipal electric-light plant and waterworks system, for which bonds to the amount of $15,000 have been issued. W. H. Cole is chairman of finance committee.

BENNETTSVILLE, S. C.—Within the next 12 months the board of electric light commissioners expects to purchase a 200-kw engine-driven generating unit for the municipal electric light and water plant; also to purchase in the near future a motor-driven turbine pump. E. C. Morrison is manager.

CHARLESTON, S. C.—The Charleston-Isle of Palms Trac. Co., of Charleston, has completed the erection of a substation in which switchboard and wiring is now being installed (primary voltage 6600, railway 550). Rotaries will be installed within the next two months. The company has just completed the work of laying cable across Cooper River, 1¼ miles wide (three-phase, 6600 volts, having a capacity of 4000 hp), connecting the new city power station of the Charleston Consol. Ry. & Ltg. Co. with the substation of the Isle of Palms Trac. Co. Equipment for substation has been purchased from the General El. Co., consisting of two 300-kw rotaries, nine-panel switchboard, etc. This cable will furnish electricity for lamps and motors in Mount Pleasant, Sullivan's Island, Government Reservation on Sullivan's Island, Atlanticville and the Isle of Palms. The power house of the Isle of Palms Trac. Co. has been closed down and will be used as an auxiliary. W. W. Fuller is chief engineer and general superintendent of the company.

GREER, S. C.—The city of Greer, it is reported, will ask for bids for the construction of an electric-light plant, waterworks and sewer system, for which, it is said, $67,000 in bonds have been issued.

LAKE CITY, S. C.—The contract for the construction of the municipal electric-light plant is reported to have been awarded to J. Newton Johnston, of Florence. The cost of the plant is estimated at $12,000, and it is to be completed within three months.

CARTERSVILLE, GA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 31, for construction, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Cartersville. Drawings and specifications may be obtained at the above office or from the custodian of site at Cartersville. O. Wenderoth is supervising architect.

HARTWELL, GA.—The Franklin Lt. & Pwr. Co., it is reported, contemplates the construction of two steam electric generating plants in Hartwell, to develop 5000 hp, with hydroelectric developments to follow. The company will erect a 40-mile transmission line, to cost $50,000, connecting Hartwell, Lavonia, Conan, Bowersville and Royston, Ga. The total cost of the plants is estimated at $100,000.

BUNNELL, FLA.—Lambert & Moody, owners of the local electric-light plant, it is reported, contemplate enlarging their plant.

JACKSONVILLE, FLA.—The special committee of the board of bond trustees has accepted the plans submitted by Sargent Hamilton, architect, for the erection of a new pump house and electrical substation. The cost of the work is estimated at $35,000.

MICANOPY, FLA.—At an election held recently the citizens voted to issue bonds to the amount of $10,000 for the installation of a municipal electric-light plant.

CHATTANOOGA, TENN.—The Chattanooga Plow Co. is reported to have decided to substitute electricity for steam power and will install 300 hp in motors. Electricity for operating the plant will be obtained from the Chattanooga Ry. & Lt. Co.

DAYTON, TENN.—The Dayton Lt. & Pwr. Co., recently incorporated with a capital stock of $100,000 by J. L. Frost and others, will distribute electricity generated at the plant of the Tennessee River Pwr. Co. on the Ocoee River. The company will erect its own transmission line from Dayton, Tenn., to connect with the main line of the Tennessee Pwr. Co.

DRESDEN, TENN.—The corporation of Dresden has engaged Phillip A. Porter, of Clinton, Ky., engineer, to take charge of the construction of the proposed municipal electric-light and water plant, for which bonds to the amount of $27,000 were recently voted. Work will begin on the proposed plant as soon as the weather will permit. W. W. Fuller is recorder.

JACKSON, TENN.—We are informed that the $25,000 bond issue, recently authorized, will be issued to pay for the present plant. No new work is contemplated. Reported in the issue of Jan. 31 to have issued bonds for improvements and extensions to the municipal plant. H. M. Harris is secretary.

OVOCA, TENN.—An electric-lighting system will be installed at the Widows & Orphans' Home of the Knights of Pythias at Ovoca, to furnish electricity to light the buildings and grounds. The plant will have an output of 11 kw and will be driven by a waterwheel, using water from Lake Ovoca transmitted through a 6-in. pipe. The cost is estimated at $2,000. All supplies have been purchased. G. M. Whitson, of Tullahoma, is engineer in charge.

ARKADELPHIA, ARK.—The Arkansas Pwr. Co., which recently took over the property of the Arkadelphia El. Lt. Co., is reported to be contemplating improvements to the electric-light plant and water-works system, to cost about $15,000. H. C. Couch, State National Bank Building, Little Rock, is president.

LITTLE ROCK, ARK.—The Arkansas Railroad Commission has granted extensive water-power rights on White River and its tributaries to Charles A. Burton, of Chicago, Ill., who, it is said, represents a syndicate which is prepared to erect a large hydroelectric power plant, to cost from $2,500,000 to $3,000,000, and to transmit electricity to Little Rock and eastern Arkansas.

NEW ORLEANS, LA.—Initial plans for the installation of an ornamental lighting system on North Rampart Street have been perfected by E. E. Lafaye, commissioner of public property. This is the nucleus of a lighting system which will extend along Rampart Street to Esplanade Avenue and on Esplanade Avenue to the City Park.

AMARILLO, TEX.—The City Lt. & Wtr. Co., of Amarillo, has just completed a new fireproof power house and has purchased a 750-kw Allis-Chalmers condensing turbine with Le Blanc condensers and two 350-hp Heine type boilers. Guy W. Faller is general superintendent.

ARANSAS CITY, TEX.—The city of Aransas Pass, it is reported, has engaged M. Griffin O'Neil & Sons, of Dallas, to prepare plans and specifications and supervise the construction of the proposed municipal electric-light plant and waterworks system. Present plans provide for the development of 125 hp. Oil engines will be used.

BARTLETT, TEX.—Within the next three months W. V. Irvine, owner of the local electric-light plant, expects to purchase two boilers, two engines and two dynamos.

BAY CITY, TEX.—The Texas Pub. Ser. Co., Bay City division, expects to erect within the next 30 days a fireproof boiler room and make general repairs to its light and ice plants; also to purchase three 125-hp boilers. Robert M. McCandlish Engineering Co., Midland Building, Kansas City, Mo., has charge of construction. W. C. Duncan is manager.

BRYAN, TEX.—The Bryan Pwr. Co. expects to erect within the next four months 5 miles of three-phase, 2300-volt transmission line to the Agriculture and Mechanical College; also to purchase one 300-kva, alternating-current, 60-cycle, 2300-volt generator for direct connection to a 500-hp Diesel oil engine. Jordan T. Taylor is vice-president and manager.

CISCO, TEX.—The Western Lt. & Pwr. Co., of Cisco, expects to erect within the next six months 72 miles of transmission lines and to purchase material for same. The company carries electrical appliances and supplies, which are bought as needed. Henry Benham is manager.

CORSICANA, TEX.—Since Jan. 1 the Corsicana Gas & El. Co. has been furnishing electricity in Kerens and Powell for lamps and motors over a 14-mile transmission line (11,000 volts, three-phase, 60 cycles). Other extensions and improvements are being made by the company to its service in Corsicana, it having recently equipped the plant of the Corsicana Brick Co. for electrical operation. It also has recently closed a contract with the Oil City Iron Works to equip its plant with motor-driven machinery, replacing gas engines. J. W. Carpenter is president and manager.

DALLAS, TEX.—Bids will be received by the County Commissioners of Dallas

County, addressed to C. E. Gross, county auditor, Dallas, until March 11, for the complete installation of high and low pressure power-plant piping, engines, boilers, generators, motor-generator set, switchboard, cabling of generators, switchboard wiring, etc., to be installed in the Dallas County Criminal Courts and Jail Building. Bids are to be submitted for the entire work. Separate bids may be submitted on each of the different types of apparatus. Plans and specifications can be obtained at the office of H. A. Overbeck, architect, 501 Juanita Building, Dallas, upon deposit of $25, to be refunded upon return of same.

EDNA, TEX.—The Edna Ice & Lt. Co. expects to change its system from direct current to alternating current in the near future, and will purchase a 75-kw generator and a 90-hp crude-oil engine. When this change is made the company will establish a day service. Rudolph Limiartz is manager.

FENTRESS, TEX.—The Fentress Gin Co. expects to erect within the next 30 days 2500 ft. of No. 2 wire line for lighting purposes. J. C. Dauchy is owner.

GIDDINGS, TEX.—Within the next six months owners of the Giddings electric-light works expect to erect 2½ miles of aerial transmission lines and to purchase 5-kva transformers, one car load of 30-ft. poles, 7 miles of No. 6 and No. 8 B. & S. wire; also 75 meters to complete meter system, one transformer and complete outfit for a series street-lighting system of 100 lamps and a general line of household labor-saving devices and fans within the next three months; also to purchase within the next six months one 175-hp boiler. The Giddings Cotton Oil Co. has purchased the interest of H. M. Walters in the plant. L. B. Adams is foreman of the electric plant.

GONZALES, TEX.—The Citizens' El. Lt. & Pwr. Co., of Gonzales, is building an auxiliary steam power plant.

MARSHALL, TEX.—The Marshall El. Co. is now installing two 400-hp Heine boilers, one 500-kw turbo-generator, one 200-kw rotary converter for railway service, exciter unit and switchboards. Charles A. Heyck is superintendent.

MIDLOTHIAN, TEX.—Within the next six months Charles J. Miller, manager of the local electric-light plant, expects to purchase one 60-hp steam engine; also to expend within the next 12 months $400 for incandescent lamps, $300 for heating and cooking apparatus and $1,000 for wiring supplies.

MISSION, TEX.—The Chamber of Commerce is reported to be interested in a proposal to construct an electric-light plant and ice factory in Mission.

Pacific States

TACOMA, WASH.—The City Council has passed an ordinance requiring all electric-light, power, telephone and telegraph wires on A Street, Pacific Avenue and C Street, in the business section of the city, to be placed in underground conduits before the installation of the new ornamental street-lighting system.

EUGENE, ORE.—The City Council has authorized the installation of new street lamps on Lawrence Street, Tenth Avenue West, Hillyard Street, Fifteenth Avenue East, Sixteenth Avenue East, Fairmont Boulevard and Eleventh Street, plans for which are being prepared by the city engineer.

HOOD RIVER, ORE.—The citizens of the valley at a mass meeting held at the Commercial Club recently voted to organize about 10 square miles of the valley into a municipality under a commission form of government to develop public utilities. The first project to be undertaken will be the establishment of a municipal lighting plant. Farmers in this section and prominent business men of this city have agreed to finance the project if the proposition of forming a municipality fails to carry at a special election. A. J. Mason, of Hood River, is at the head of the movement.

MILTON, ORE.—At the election to be held in March the proposal to issue $1,800 in bonds for extensions and improvements to the municipal electric-light plant will be submitted to the voters.

CALEXICO, CAL.—We are informed that the city of Calexico does not contemplate the installation of a municipal electric-light plant, as reported in the issue of Feb. 14. R. L. Glasby is city clerk.

HUNTINGTON BEACH, CAL.—The Pacific Oil Cloth & Linoleum Co., which is establishing a factory in Huntington Beach, has decided to equip the plant with electrically operated machinery. Gustav Frenkel is manager.

LOS ANGELES, CAL.—The State Railroad Commission has granted the Southern California Edison Co., of Los Angeles, permission to issue $1,500,000 in bonds, the proceeds to be used for general improvements to its system and for promoting several individual projects. R. H. Ballard, of Los Angeles, is secretary and assistant general manager.

RIVERSIDE, CAL.—The residents of Seventh Street are arranging for the installation of ornamental electroliers along that thoroughfare in the near future. The cost of the system is estimated at more than $4,000.

SAN FERNANDO, CAL.—Application has been made to the State Railroad Commission by the San Fernando Mission Land Co. and John T. Wilson for authority to sell their distributing systems in the San Fernando Valley to the Pacific Lt. & Pwr. Corpn., of Los Angeles. The San Fernando Mission Land Co. has agreed to sell its property for $7,835, and Mr. Wilson places a valuation of $16,000 on his holdings. It is understood that extensions will be made to these systems when they have been taken over by the Pacific Corpn.

SOUTH PASADENA, CAL.—The public utility corporations in this city have been instructed by the city trustees to place their lines either in underground conduits or along the alleys. All the wooden poles are to be taken from the streets.

FOUNTAIN GREEN, UTAH.—The Bix Springs El. Co., of Fountain Green, will receive bids for equipment for its new power plant until March 10. The new power house will be completed about June 1 and will have an output of about 200 kw. A three-phase system will be installed. Ernest Anderson is superintendent.

SALT LAKE CITY, UTAH.—Bids will be received by the University of Utah, Salt Lake City, Utah, until March 7, for furnishing and installing electric-lighting fixtures in the central building, University of Utah, at Salt Lake City, according to plans and specifications prepared by Cannon, Fetzer & Hansen, 506 Templeton Building, Salt Lake City, where plans and specifications may be seen.

SUPERIOR, ARIZ.—The Board of County Commissioners of Pinal County has granted a franchise for the installation of an electric-light plant and water-works system in Superior.

THATCHER, ARIZ.—The Town Council has called an election to be held March 14 to vote on the proposal to grant the Gila Valley El., Gas & Wtr. Co., of Globe, a franchise in Thatcher.

GLENDIVE, MONT.—The City Council has passed an ordinance providing for the installation of an ornamental lighting system on Merrill Avenue, to cost about $5,000. For further information address Elnar Rivenes.

HAYDEN, COL.—The Hayden Concrete Gas & El. Co. expects to purchase next summer one primary switch, 2300-volt, and small board for same, material for street-lighting system and from 14 to 25 100-watt tungsten lamps. The company's contract for incandescent lamps expires in April. M. F. Hofstetter is secretary.

GOLCONDA, NEV.—J. B. Fayant has applied to the Board of County Commissioners of Humboldt County for a franchise to erect and operate electric transmission lines in the town of Golconda.

ROCHESTER, NEV.—Application has been made to the State engineer by H. J. MacSherry, of Rochester, for permission to appropriate water rights from Coyote Creek for power purposes.

Canada

CALGARY, ALTA.—The Eau Claire & Bow River Lumber Co. is installing two 50-in. Samson turbines in its water-power plant; it also contemplates the installation of gas engines to develop 1500 hp. This company is closely associated with the Calgary Wtr. Pwr. Co. P. A. Prince is manager.

MEDICINE HAT, ALTA.—Plans are being prepared for an electric (high-tension) distributing system, to cost about $10,000; for a street-lighting system to cost $20,000; also an addition to the municipal electric generating station.

PORTAGE LA PRAIRIE, MAN.—The city of Portage la Prairie has applied to the Provincial Legislature for an extension of its charter rights allowing it to erect a transmission line outside of the city and to supply electricity for power purposes.

BURFORD, ONT.—A by-law authorizing the Council to contract with the Hydro-Electric Power Commission of Ontario for electricity for the municipality will be submitted to the ratepayers on March 9.

COBDEN, ONT.—A committee has been appointed by the Village Council to investigate and report at the next meeting of Council upon the probability of obtaining a suitable water-power site for the purpose of generating sufficient electricity to light the streets and residences and for general use in the village.

EMBRO, ONT.—The question of securing electricity generated at Niagara Falls from the Hydroelectric Power Commission is under consideration by the Council.

FORT WILLIAM, ONT.—The Kaministiquia Pwr. Co., Ltd., will increase the output of its power plant by 14,000 hp. Contracts for material have been placed. W. L. Bird is secretary and manager.

GALT, ONT.—The Town Council is contemplating the installation of an electric fire-alarm system in Galt.

NIAGARA FALLS, ONT.—The town engineer recommends the installation of a lighting system on the River Road, for a distance of 2 miles, using ornamental standards, with arc or incandescent lamps.

STRATFORD, ONT.—A by-law has recently been passed authorizing an expenditure of $20,000 for extensions and improvements to the municipal electric-light system.

SUDBURY, ONT.—The Town Council is considering the installation of an ornamental street-lighting system on Main Street; also an addition to the municipal electric-light plant.

TORONTO, ONT.—The possibility of utilizing the water-power on the Quinze River, near the head of Lake Temiskaming in northern Ontario, for generating electricity is under consideration. M. J. O'Brien, who owns water rights for a distance of 2 or 3 miles, including falls and rapids, has engaged Messrs. Sutcliffe & Neelands, civil engineers, of Toronto, to make investigations with a view of developing same.

BUCKINGHAM, QUE.—The Town Council is contemplating the installation of an electric-lighting system.

BURY, QUE.—The Westbury Ht., Lt. & Pwr. Co. is negotiating with the Town Council for a 20-year franchise to furnish electricity to this municipality.

HUMBOLDT, SASK.—The town of Humboldt has awarded the contract for equipment for the municipal electric-light plant to the Canadian General Electric Co., of Toronto, including two 100-hp Leonard & Sons boilers, a 200-hp tandem compound engine, one 125-kw, 60-cycle, 2200-volt generator, general switchboard apparatus, transformers (50-kw), 300 cedar poles, 10 miles of overhead line, 100 Packard meters and 700 incandescent lamps. F. K. Martin is electrical superintendent.

New Incorporations

CANAAN, N. H.—The Canaan El. Lt. Co. has been chartered with a capital stock of $12,000. The incorporators are Harris J. Ross, B. M. Barnard, Joseph Tighe and Ernest Noyes, of Canaan; C. F. Gardner, of Raymond.

BENNINGTON, OKLA.—The Bennington Ice, Lt. & Pwr. Co. has been incorporated with a capital stock of $5,000 by H. C. Clark, W. S. Murphy and J. S. Dawson.

HUNTINGTON, OKLA.—The Huntington El., Lt. & Pwr. Co. has been incorporated with a capital stock of $8,000. The officers are: John Degen, president; J. A. Finney, vice-president; H. E. Cunningham, secretary; H. Mayer, treasurer; O. B. Young, general manager. Huntington has not a post office.

ANDERSON, S. C.—The Walhalla Lt. & Pwr. Co. has been granted a charter with a capital stock of $10,000. The incorporators are William A Strother and Jesse W. Bell.

TORONTO, ONT.—The Interurban Co., Ltd., has been incorporated with a capital stock of $5,000,000 with the names of the incorporators nominally given as clerks in a Toronto legal office usually associated with the MacKenzie & Mann enterprises. The company is empowered to deal in all kinds of bonds and debentures, to develop water-power, establish and develop lighting or power plants and generally to carry on any kind of manufacturing or industrial enterprise.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 17, 1914.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,087,113. Machine for Receiving Electric Waves; R. Goldschmidt, Berlin, Germany. App. filed Dec. 10, 1912. Renders intercepted energy of electric waves perceptible in telephones by commutator rotated asynchronously to frequency of intercepted waves.

1,087,120. Indicating Means for Inclosed Fuses; D. C. Hooker, Farmington, Conn. App. filed Feb. 7, 1913. Paper of dielectric strength insufficient to resist potential after the fuse is disrupted sets off fulminate.

1,087,126. Arrangement for Producing Slightly Damped Electrical Oscillations; B. Macku, Brunn, Austria-Hungary; L. Mandelstam and N. Papalexi, Strassburg, Germany. App. filed April 26, 1911. When discharge at spark-gap takes place spark is immediately quenched and circuit oscillates further without a spark-gap and is accordingly but slightly damped.

1,087,127. Telephonic Receiver; A. Marr, Manchester, Eng. App. filed Jan. 8, 1913. Diaphragm loosely held at the edge so as to vibrate with greater freedom.

1,087,128. Telephonic Receiver; A. Marr, Manchester, Eng. App. filed Jan. 8, 1913. "Western Electric" type in which no screws enter the ends of the magnet limbs.

1,087,131. Electric Contact Device; T. H. McQuown, Cambridge, Mass. App. filed Jan. 5, 1909. For ignition circuits; time of contact is constant irrespective of engine speed.

1,087,143. Primary Battery; A. L. Saltzman, East Orange, N. J. App. filed Oct. 4, 1911. Special construction of bolt and supporting frame or hanger for the suspended electrode.

1,087,166. Dynamo-Electric Machine; A. M. Gray, Milwaukee, Wis. App. filed Sept. 30, 1909. Ventilating ducts and fan blades on rotor.

1,087,170. Controller; A. J. Loguin, Norwood, Ohio. App. filed March 23, 1912. Potential starter with means for positively stopping the controller handle in certain positions before it can be moved further.

1,087,180. Apparatus for Amplifying or Detecting Electrical Variations; G. W. Pierce, Cambridge, Mass. App. filed Nov. 26, 1913. Gaseous conducting medium upon which the electrical variations are impressed in such manner as to modify the current in a local circuit through the gas.

1,087,189. Measuring Instrument; E. O. Schweitzer, Chicago, Ill. App. filed Feb. 14, 1912. For measuring flow of liquid or gaseous fluid.

1,087,198. Electric Heating Unit; C. S. Steward, Chattanooga, Tenn. App. filed Nov. 12, 1913. Disk carrying resistance wire and having trunnions which connect with source of current when placed in the heater.

1,087,199. Electric Stove; C. S. Steward, Chattanooga, Tenn. App. filed Nov. 12, 1913. Heating chamber beneath the stove utilizes waste heat from the heating units and prevents upward rush of cold air against units.

1,087,200. Electric Oven; C. S. Steward, Chattanooga, Tenn. App. filed Nov. 12, 1913. For cooking with either a dry or a moist heat; heater units at top and bottom of oven, independently controlled.

1,087,218. Carburetor; H. M. Dalton and C. M. Conklin, Cincinnati, Ohio. App. filed Aug. 9, 1912. Has primary and secondary air and fuel valves and avoids use of float.

1,087,231. Automatic Controlling Device for Heating Apparatus; E. E. Gold, New York, N. Y. App. filed Jan. 29, 1913. For cars, etc.; thermostat controls and electric heater which actuates thermostatic controlling means to cut off flow of steam to radiator.

1,087,236. Storage Battery Electrode and Process of Making Same; H. C. Hubbell, Newark, N. J. App. filed June 6, 1911. Nickel strips alternated with cadmium oxide.

1,087,237. Process of Making Storage-Battery Electrodes; H. C. Hubbell, Newark, N. J. App. filed June 8, 1911. Alternate layers of copper, cobalt and nickel.

1,087,238. Electric Switch; G. L. Hughes, Chicago, Ill. App. filed Nov. 18, 1912. Combined manually and automatically operated switch having plurality of circuit closers.

1,087,251. Electric Switch; J. A. Meaher, Cleveland, Ohio. App. filed Dec. 19, 1911. Actuated by fluid pressure to throw pump motor into and out of operation.

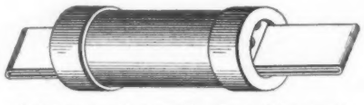
1,087,289. Storage-Battery System; E. A. Halbleib, Rochester, N. Y. App. filed Dec. 16, 1910. For car lighting.

1,087,355. System of Control; L. Dreyfus, Nieder-Schönhausen, Germany. App. filed July 18, 1912. Voltage impressed on armature winding may be varied but remains substantially in phase with voltage induced in the armature by the resultant field.

1,087,357. Cut-Out and Fuse Mechanism; E. B. Ellicott, Chicago, Ill. App. filed Jan. 4, 1909. For high-tension systems.

1,087,377. Arc Lamp; C. C. Hughes, Philadelphia, Pa. App. filed Aug. 31, 1911. One of the carbons is automatically adjusted through the medium of a thermo-expansive wire.

1,087,381. Brush for Dynamo-Electrical Machines; E. C. Ketchum, Boston, Mass., and D. H. Andrews, Newton, Mass. App. filed Oct. 16, 1912. Copper plates separated at base ends by narrow copper shims and all soldered together.



1,087,853—Renewable Cartridge Fuse

1,087,383. Device for Preventing Formation of Burs in Electric Welding; W. A. Kilmer, De Kalb, Ill., and A. T. Weaver, Joliet, Ill. App. filed Aug. 23, 1912. Brushes rotate transversely of wire being welded.

1,087,384. Method of and Apparatus for Preventing Formation of Burs on Electric Welds; W. A. Kilmer, De Kalb, Ill.; A. T. Weaver, Joliet, Ill. App. filed Aug. 23, 1912. Rapidly rotating brushes wipe off the surplus metal during the welding operation.

1,087,417. Fuse Holder; H. W. Young, Chicago, Ill. App. filed Oct. 7, 1912. Longitudinally divided hollow casing.

1,087,453. Electric Distributing Device; R. H. Manross, Forestville, Conn. App. filed March 4, 1912. Lighting switch for automobiles.

1,087,461. Current-Controlling Mechanism; L. T. Rhoades, Mont Clare, Pa. App. filed March 19, 1913. Igniter producing a single uniform spark for every explosion, regardless of speed.

1,087,494. System of Electric-Motor Control; H. D. James, Pittsburgh, Pa. App. filed May 9, 1908. For operating top mechanism of blast furnaces, etc.; brings motor to rest after it has performed its predetermined cycle of operations.

1,087,500. Circuit-Breaker; H. G. MacDonald, Pittsburgh, Pa. App. filed June 8, 1908. Oil-immersed.

1,087,518. Electric Heater; J. G. Wallmann, Oakland, Cal. App. filed March 18, 1913. Boiler with non-contacting resistance wires.

1,087,537. Circuit-Changer for Electric Railways; B. F. Hutches, Jr., Allendale, N. J. App. filed March 14, 1912. Avoids collisions by cutting off current to cars in safety zones adjoining that zone through which a car is traveling.

1,087,549. Receiver for Wireless-Transmission Signals; V. Poulsen, Copenhagen, Denmark. App. filed Sept. 16, 1905. Wave detector normally has current from the source passing continuously therethrough.

1,087,556. Electric Motor; H. K. Sandell, Chicago, Ill. App. filed Nov. 7, 1911. Reciprocatory type.

1,087,592. Electric Heater; F. Kuhn, Detroit, Mich. App. filed April 5, 1912. For attachment to a coffee urn or other cooking utensil.

1,087,593. Electrically Heated Foot-Warmer; F. Kuhn, Detroit, Mich. App. filed April 9, 1912. Resistor wire surrounded by insulating material inclosed in a frame.

1,087,594. Electric Heater; F. Kuhn, Detroit, Mich. App. filed Oct. 5, 1912. May be engaged with different utensils and the heating element may be detached from both the base and the utensil.

1,087,595. Electric Heater; F. Kuhn, Detroit, Mich. App. filed Oct. 5, 1912. Stand with cup receiving the heater unit on the bottom of the utensil.

1,087,596. Circuit-Opening Switch for Electric Heaters; R. Kuhn, Detroit, Mich. App. filed Oct. 10, 1912. Connector plug performs the additional function of a snap switch; for use with sadirons.

1,087,607. Electric Steam Heater; C. C. Ponting, Medford, Ore. App. filed March 13, 1913. Radiator receives steam from an electric heater incorporated in the base of the radiator.

1,087,612. Dry-Cell Battery; C. W. Simmons, East Cleveland, Ohio. App. filed Feb. 11, 1913. One cell unit is nested within another like unit.

1,087,637. Separator for Storage-Battery Plates; C. C. Carpenter, Niagara Falls, N. Y. App. filed June 22, 1912. Body of wood or the like, impregnated or coated with rubber.

1,087,651. Spark Collector and Distributer; M. Gerardy, Wathena, Kan. App. filed July 27, 1912. Timer and distributer for use on magneto or battery.

1,087,673. Steady Strain Device for Trolley Construction; O. S. Lyford, Jr., New York, N. Y. App. filed Aug. 12, 1909. For holding trolley wires against lateral displacement, especially in catenary trolley constructions.

1,087,704. Head Support for Telephone Receivers; C. Adams-Randall, Boston, Mass. App. filed Feb. 19, 1913. Head band secured on head without pressure on the ears, and the receivers are frictionally held in adjusted position.

1,087,705. Method for Producing Abrasive Compounds; T. B. Allen, Niagara Falls, N. Y. App. filed July 3, 1913. Produces "garnet" from mixture of magnesia, alumina and silica, which is melted, slowly cooled, removed from furnace while still heated, and crushed in the presence of water.

1,087,853. Renewable Cartridge Fuse; N. D. Urquhart, Glenwood Springs, Col. App. filed May 6, 1913. Has end contact blades folded to embrace and grip the ends of the fuse strip.

1,087,880. Electrical Controller; D. J. Hauss, Aurora, Ind. App. filed June 29, 1911. Single-controller lever has one movement for varying the speed of the motor and another movement for starting and stopping the motor.

1,087,887. Electric Water Heater and Steam Generator; A. P. Nichols, Seattle, Wash. App. filed April 5, 1911. Water is caused to flow through the heater in a thin sheet.

1,087,892. Means for Receiving Electrical Oscillations; W. Schloemilch and O. von Bronk, Berlin, Germany. App. filed March 14, 1913. Amplitude of oscillations is increased to extent permitting use of a detector such that oscillations can be perceived more distinctly.